M.Sc. Mathematics **Prospectus No. 2015129**

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SANT GADGE BABA AMRAVATI UNIVERSITY

विज्ञान विद्याशाखा
(FACULTY OF SCIENCE)

अभ्यासक्रमिका
विज्ञान पारंगत सत्र-१ ते ४
(गणित)

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OF
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M.Sc. (Mathematics) Prospectus No.2015129

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

M.Sc. Part-I (Mathematics)

M.Sc. Part-I -Semester I :

Compulsory Papers

Paper-I : (101) Real Analysis

Paper-II : (102) Advanced Abstract Algebra-I

Paper-III : (103) Complex Analysis-I

Paper-IV : (104) Topology-I

Optional Papers : Choose Any One.

Paper-V : (105) Differential Geometry-I

Paper-V : (106) Advanced Discrete Mathematics-I

Paper-V : (107) Differential and Integral Equations-I

M.Sc. Part-I -Semester II :

Compulsory Papers

Paper-VI : (201) Measure and Integration Theory

Paper-VII : (202) Advanced Abstract Algebra-II

Paper-VIII : (203) Complex Analysis-II

Paper-IX : (204) Topology-II

Optional Papers: Choose Any One.

Paper-X : (205) Riemannian Geometry

Paper-X : (206) Advanced Discrete Mathematics-II

Paper-X : (207) Differential and Integral Equations-II

M.Sc.-I (MATHEMATICS)

SEMESTER-I

PAPER-I (101): REALANALYSIS

Unit-I : Definition and existence 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 : Sequences and uniform convergence, Cauchy criterion for uniform convergence, Weierstrass M-test, Abelôs and

Dirichletôs tests for uniform convergence, uniform convergence and continuity , uniform conver gence and integration, uniform convergence and differentiation, Weierstrass approximation theorem.

Unit-III : Rearrangement of terms of a series, Riemannôs theorem. Power series, Uniqueness theorem for power series, Abelôs limit theorem, Tauberôs first 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 , Taylorôs theorem.

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

Text Book :

Walter Rudin; Principles of Mathematical Analysis, Mc Graw HillBooks 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 andW inston, 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, FrederickUngar 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 : Mathematical Analysis, Wiley Fastern Ltd., New Delhi.

(13) S.C.Malik and Savita Arora : Mathematical Analysis, New Age International (P.) Ltd.2010, Fourth Edition.

(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 RealAnalysis, 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 AnalysisWiley 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

Paper -II (102): Advanced Abstract Algebra-I

Unit-I : Automorphisms, conjugacy, Class Equation of Finite Groups and G-Sets. Normal series,solvable groups, Nilpotent groups.

Unit-II : Direct products, fundamental theorem of finitely generated Abelian group, Invariants of a finite Abelian group, Sylowô s theorems, group of order P^2 , pq,

Unit-III : Ideals, Nil Potent and Nil Ideals, Euclidean Ring .

Unit-IV : Polynomial Ring, Integral Domain,Principal Ideal Domain, Unique Factorization Domain,Euclidian Domain, Polnomial Rings over unique factorization domain.

Unit-V : Cyclic modules, simple modules, Shurôs lemma, free module, Noetherian and Artiniam Module and rings, Hilbert basics 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 .

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, 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 Colleg 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 V ol.204, Springer , 2001.

14) T . Y .Lam, Lectures on Modules and Rings. GTM V ol.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., Modren Algebra, Krishana prakashan media (P) Ltd.

18) V.K. Khanna and Bhamari., A course in Abstract Algebra, Vikas publishing House(p) Ltd(2010).

19) John B. Fraleigh., A first course in Absrtact Algebra (Seventh Edition)

20) Abstract Algebra (2^{nd} Edition) By David S. Dummit Richand M. Frrte Wilay India Edition.

PAPER-III (103) : COMPLEX ANALYSIS - I

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

Unit-II : Taylorôs theorem, Maximum Modulus theorem, Moreraôs theorem, Counting of zeros, Open Mapping theorem, Cauchy-Goursal theorem, Schwarzôs lemna.

Unit-III : Singularities, Isolated singularities, classification of isolated singularities, Laurents series development, Casorti-Wierstrass theorem, Argument principle, Rouches theorem.

Unit-IV : Residue, Cauchyôs residue theorem, Evaluation of integration by using residue theorem, Branches of many valued function (Specially arg z, log z, z), Bilinear transformation, Hadamardô 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 W esley , 1977.1998.
5) D.Sarason, Complex Function Theory , Hindustan Book, Agency ,Delhi, 1994.
6) Mark J. Ablowitz and A.S.Fokar , Complex V ariables : Introduction& Applications, Cambridge University Press, South Asian Edition,56
7) E.Hille, Analytic Function Theory (2 V ols), Gonn & co. 1959.
8) W.H.J.Fuchs, Topics in the Theory of Functions of one complexvariable, D.V an Nostrand Co., 1967.
9) C.Caratheodory , Theory of Functions (2 V ols), Chelsea Publishing Company , 1964.

10) M.Heins, Complex Function Theory , Academic Press, 1968.
11) W alter 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.V eech, A secord course in Complex Analysis, W . A.Benjamin,1967.
15) S.Ponnusamy , Foundation of Complex Analysis, Narosa PublishingHouse, 1997.
16) Murray R. spiegel, Seymour Lipschutz, Jon J.Schiller, Dennis Spellman., SCHAUMòS Outlines Complex variable. Tata Mc Graw Hill Eduction Private Ltd. New Delhi 3rd. Edition 2010.
17) Compex variables and Applications Jams Ward Brown, Ruel V. Churchill MCGRAW-HILL INTERNATIONAL EDITION (2009)
18) H.S. Kasana,Complex variables: Theory and Applications , PHI Learning Private LTd. New Delhi
19) Dennis G. Zill, Patrick D. Shanhan Jones and Burtlett, A first course in Complex analysis with application (Second edition) publisher (2010).
20) J. Ward Brown, Ruel V. Churchill, Complex variables and applications, McGraw- Hill International edition (2009).
21) J.N. Sharma, Complex variables, Pragati publication.
22) A.R. Vasistha, Complex variables, Krishna publication.
23) John Mathew and Howell, Complex analysis for mathematician and Engineers.
24) Schaumôs outline series, Complex analysis, Tata McGraw Hill Education Pvt. Ltd., New Delhi (2010)

PAPER-IV 104 : 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, Urysohn Lemma, Tietze Extension Theorem. Completely regular spaces.

Text Books :

(1) Foundations of General T opology by W illiam 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 T opics by Semour Lipshutz Publisher: Schaum Publishing Co., New York.

(2 J.R. Munkres, Topology : A First CoursePublishers Prentice Hall of India.

(3) K.D.Joshi, Introduction to General Topology , Publisher , Wiley Eastern Ltd.

(4) By R.S.Aggarwal A Text Book on Topology , Publisher : S.Chand & Company .

(5) J.N. Sharma, General and Algebric Topology, Krishna prakashan Pvt. Ltd.

PAPER-V (105) : 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 : 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.

Text Books : ñAn Introduction to Differential Geometryò, By T .J.Wilmore, Oxford University Press (1959)

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.

PAPER-V (106) : 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 S tructure 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.

PAPER-V (107) : 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, Greenô 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 : Lassy Andrews, Bhimsen Shivamosgo, Integral Transform for Engineers, Prentice Hall of India (2003).

References :

(1) W. T. Reid, Ordinary Dif ferential 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. 910

SYLLABUS PRESCRIBED FOR M.Sc. -II

SEMESTER-II

PAPER-VI (201) : 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 L^p uniqueness of Extension, completion of a measure, measure spaces, integration with respect to a measure. spaces, convex functions, Jensenôs inequality . Holder and Minkowski inequality .Completeness of L^p convergence in measure. Almost Uniform conver gence.

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., Lebesgueôs 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.

PAPER-VII (202) : ADVANCED ABSTRACT ALGEBRA-II

Unit-I : Field, 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 module 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 : P .B.Bhattacharya, S.K.Jani, S.R.Nagpaul, Basic Abstract Algebra,

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 W iley & Sons, 1982, 1989,1991.

4) N. Jacobson, Basic Algebra, V ols. 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, V ol. I-Groups, Vol. II-Rings, Narosa Publishing House

7) D.S. Malik, J.N. Mordenson, and M.K.Sen, Fundamentals ofAbstract 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 MA TLAB, 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 V ol.204, Springer , 2001.

14) T. Y .Lam, Lectures on Modules and Rings. GTM V ol.189, Springer -Verlag, 1999.

15) D.S.Passman, A Course in Ring Theory , Wadsworth and Brooks/ Cole Advanced Book and Softwares, Pacific Groves, California,1991.

16) J.A. Gallian .,contemporary Abstract Algebra, Narosa publication

17) A.R. Vashistha., Modren Algebra, Krishana prakashan media (P) Ltd.

18) V.K. Khanna and Bhamari., A course in Abstract Algebra, Vikas publishing House(p) Ltd(2010).

19) John B. Fraleigh., A first course in Absrtact Algebra (Seventh Edition)

20) Abstract Algebra (2nd Edition) By David S. Dummit Richand M. Frrte Wilay India Edition

PAPER-VIII (203) : COMPLEX ANALYSIS-II

Unit-I : The Gamma function and its properties, the Riemann Zeta Function, Remannôs Functional Equation, Eulerôs theorem, Mittag-Lefflerôs 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, Harnackôs inequality , Dirichletôs problem, Greenôs function.

Unit-IV : Canonical products, Jensenôs formula, Poisson-Jensen formula, The genus and order of an entire function, exponent of conver gence, Hadamardôs factorization theorem.

Unit-V : The range of an analytic function, Bloch theorem, Little theorem

Text Book :

Picards theorem, Schottkyô s theorem, univalent functions, Bieberbachôs conjecture (S tatement only), Cobeôs ñ1/4ò

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 , 1977.1966.
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.V an 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) W alter Rudin, Real & Complex Analysis, McGraw Hill Book Co.,
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.

16) H.S. Kasana,Complex variables: Theory and Applications , PHI Learning Private LTd. New Delhi
17) Dennis G. Zill, Patrick D. Shanhan Jones and Burtlett, A first course in Complex analysis with application (Second edition) publisher (2010).
18) J. Ward Brown, Ruel V. Churchill, Complex variables and applications, McGraw- Hill International edition (2009).
19) J.N. Sharma, Complex variables, Pragati publication.
20) A.R. Vasistha, Complex variables, Krishna publication.
21) John Mathew and Howell, Complex analysis for mathematician and Engineers.
22) Schaumôs outline series, Complex analysis, Tata McGraw Hill education Pvt. Ltd., New Delhi (2010)

PAPER-IX (204) : 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 : Urysohnôs metrization theorem, paracompact spaces, Nagata-Smirnov metrization theorem.

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

Reference Books :

(1) S.R.Munkres, Topology: A First Course, Publisher : Prentice Hall of India.
(2) K.D.Joshi Introduction to General Topology , Publishers : Wiley Eastern Ltd.

(3) R.S. Aggarwal A Text Book on Topology, Publisher : S.Chand & Co.

(4) J.N. Sharma, General and Algebric Topology, Krishna prakashan Pvt. Ltd.

PAPER-X (205) : RIEMANNIAN GEOMETRY (OPTIONAL)

Unit-I : Riemannian metric, metric tensor , Christoffel symbol, christoffel symbol of first kind, second kind, properties of christoffel symbols. Computations of Christoffelôs symbols for static and non-static spherically symmetric and R-W space-times ,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 compenents of R

Unit-IV : Ricci tensor, curvature invariant, Einstein tensor, Computations of Einsteinôs 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, cartesian tensor .

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 ï 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 (206) : 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. Kuratowskiô 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 Kruskalôs algorithm. Matrix representations of graphs. Euler ôs theorem on the existence of Eulerian paths and circuits. Directed graphs. Indegree and outdegree of a vertex. Weighted undirected graphs. Dijkstraôs algorithm. Strong connectivity and Warshallôs 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. Kleenôs theorem.

Unit-V : Turing machine and partial recursive functions.notation.

References :

Notions of syntax analysis, polish notations. Conversion of infix expressions to polish notations. The reverse polish

(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)

PAPER-X (207) : 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 Greenô 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 V olterra 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.V iazwaz, A First course in Integral Equations, W orld Scientific (1997)

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

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

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

Semester III: Compulsory Papers

Paper-X I	(301)	Functional Analysis-I
Paper-X I I	(302)	Classical Mechanics

Choose Any three from the following optional papers

Paper-XIII,	(303) :	General Relativity and Cosmology-I
Paper-XIV	(304):	Fluid Dynamics-I
&	(305):	Operations Research-I
XV	(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

Paper-XVI	(40 1):	Functional Analysis-II
Paper-XVII	(402) :	Partial Differential Equations

Choose Any three from the following optional papers

Paper-XVIII,	(403) :	General Relativity and Cosmology-II
XIX	(404):	Fluid Dynamics-II
&	(405):	Operations Research-II
XX	(406):	Difference Equations-II
	(407):	Fuzzy Sets and Applications-II
	(408):	Lie Groups
	(409):	Banach Algebra-II
	(410):	Non-Commutative Rings-II

SEMESTER-III

PAPER-XI (301): FUNCTIONAL ANALYSIS-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 conver gence and bounded linear transformations, normed linear spaces of bounded linear transformations, Dual spaces with example.

Unit-III : Boundedness theorem and some of its consequences, openmapping, 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, Besselôs inequality , complete orthogonal sets, Parsevalôs identity , structure of Hilbert spaces, Projection theorem.

T ext 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 Y ork, 1958.
4) R.E.Edwards, Functional Analysis, Holt Rinehart and Winston, New Y ork, 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, W iley Eastern Ltd., 1989.
12) B.V .Limaye, Functional Analysis, W iley 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 T opology and Modern Analysis,McGraw Hill Book Company , New York, 1963.
15) A.E.Taylor , Introduction to Functional Analysis, John Wiley and Sons, New Y ork, 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, T ata McGraw Hill, Publishing Company Ltd. New Delhi, 1973.
19) A.Wilansky , Function Analysis, Blaisdell Publishing Company , 1964.
20) J.T insley 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.

PAPER-XII (302) : CLASSICAL MECHANICS

Unit-I : Variational principle and Lagranges Equations : Hamiltonôs principle, some techniques of the calculus of variations. Derivation of Lagrangeô s Equations from Hamiltonôs 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, Routhôs equations, Derivation of Hamiltonôs equations from a variational principle, the principle of least action..

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

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

Text Book :

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

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

References:

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

(2) Gupta, Kumar and Sharma, Classical Mechanics

(3) T.M. Karade, G.S.Khadekar, Lectures on Advanced Mechanics, Sonu-Nilu publication

(4) I.D. Landau and E.M. Lifchitz, Vol. I third edition, Perguman press, New Delhi

303 : GENERAL RELATIVITY AND COSMOLOGY -I (OPTIONAL)

Unit-I : Newtonian Relativity, Introduction of special theory of relativity and principles of special theory of relativity, space time structure, Minkowskian space time, Relativistic mechanics, mass energy equivalence energy momentum tensors.

Unit-II : Einsteinôs relativity: SR to GR, Principle of equivalence, Principle of covariance and Machôs Principles, Einsteinôs field equations, Derivation of Einsteinôs field equations from action principle, Newtonian approximation: Relation between g_{44} and V, Einstein equations compared with poisson equation.

Unit-III : Schwarzschild exterior solution and its isotropic form, planetary orbits, General relativistic Kepler problem, Advance of Perihelion of a planet, Bending of light ray in a gravitational field, gravitational red shift in spectral lines

Unit-IV : Schawrschild interior solutions, the boundary conditions, covariant conservation law, Gravitational wave equations, Birkhoffôs theorem.

Unit-V : Eddingtonôs form of the Schwarzschild solution, Linearisation of filed equations, time independent and spherically symmetric field. Weylôs solutions to the liearized field equations

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.

(7) Dr. S. R. Roy, Dr. Raj Bali, Theory of relativity, Jaipur publishing house

(8) T.M. Karade, K.S. Adhav, M.S. Bendre, Lectures on Special relativity

(9) R. Resnicik, Introduction to special relativity, Wiley Eastern Ltd.

304: 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 path lines. 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, Eulerôs Equation of motion. Bernoulliôs 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 W a sins, 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, Maxwellôs Thermodynamics relation. Iso-thermal Adiabatic and Isentropic Process.

Text Book :

(1) F .Chorlton, T ext Book of Fluid Dynamics, CBS Publishers, Delhi,

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 Y ork, 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.

(305) : OPERATION RESEARCH-I (OPTIONAL)

Unit-I : Operation Research & its scope, linear programming, Mathematical formulation, Graphical solution, General linear programming, Simplex method,Use of Artificial variable, (Big-M method), Duality in LP. , Economic Interpretation, dual simplex method.

Unit-II : Integer Programming , Branch and Bound technique, Fractional cut plane method , Goal programming, Advanced techniques in LP(upper bound technique)

Unit-III : Parametric linear programming, Transportation problem and assignment problems.

Unit-IV : Network analysis, minimal spanning tree problem, shortest route problem, network scheduling, critical path analysis.

Unit-V : Dynamic programming, The recursive equation approach, characteristics of dynamic programming, Dynamic programming algorithm, Discrete DPP., solution of LPP by dynamic programming.

Text Book :

(1) Kantiswaroop, P .K.Gupta and Manmohan, Operations Research, Sultan Chand & Sons, New Delhi-2007.

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 & D.S.Hira, Operations Research ï An Introduction. Chand & Company Ltd, New Delhi.

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

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

306: 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 Ztransforms, 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.

T ext 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 Dif ference Equations, Springer , 1999.

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

307: 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 Zadeôs 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.

308 : 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)] 2324

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 W avelets, 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 B Verleg.

309 : 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 (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, V o n Nostrand, 1960.

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

310: NON COMMUTATIVE RINGS-I (OPTIONAL)

Unit-I : Basic Terminology and examples. Semi simplicity (x 1, x 2 of [1]).

Unit-II : Structure of Semi simple rings. (x 3 of [1]).

Unit-III : The Jacobson Radical (x 4 of [1]).

Unit-IV : The prime radical; prime and semi prime rings. Structure of primitive rings; the Density Theorem (x10, x 11 of [1]).

Unit-V : Sub-direct products and commutativity theorems. (x 12 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 , (S tudent Edition), Academic Press, 1991.

SYLLABUS PRESCRIBED FOR M.Sc. II SEMESTER-IV

PAPER-XVI 401: FUNCTIONAL ANALYSIS-II

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

T ext Book :

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

References :

(1) Serge Lang, Analysis I & II, Addison-W esley 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, S t udents 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, W iley Eastern Ltd., 1989.

(12) B.V. Limaye, Functional Analysis, W iley 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 T opology 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, Y ork, 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.

PAPER-XVII 402: PARTIAL DIFFERENTIAL EQUATIONS

Unit-I : Curves and Surfaces, Genesis of first order P.D.E., Classification of intergals, Linear Equations of the first order, Pfaffian differential Equations, Compatible systems, Charpitôs Method ,Jacobiôs Method, Integral Surfaces through a given curve.

Unit-II : Quasi-Linear equations, Non-linear first order P.D.E., genesis of second order P.D.E.,Classification of second order P.D.E.

Unit-III : One dimensional Wave equation, Vibrations of an infinite string , Vibrations of a Semi-infinite string,Riemann,s Method, Vibrations of a string of finite Length.

Unit-IV : Laplaceôs Equation, Boundary value problems, Maximum and Minimum Principles, The Cauchy problem, The Dirichlet Problem for the upper half plane, The Neumann problem for the upper half plane, The Dirichlet problem for a circle, The Dirichlet Exterior problem for a circle, The Neumann problem for a circle, The Dirichlet problem for a Rectangle , Harnackôs Theorem, Laplaceôs equation- Green funcation, The Dirichlet problem for a half plane,The Dirichlet problem for a circle.

Unit-V : Heat conduction problem**:** Heat conduction- Infinite rod case, Heat conduction-finite rod case, Duhamelôs principle:Wave equation, Heat conduction equation. Classcification in the case of n ï variables, Families of equipotential surfaces, Kelvinôs inversion theorem.

Text Book : T. Amaranath : An elementary course in Partial Differential Equations, 2nd Ed. Narosa Publishing House, New Delhi.

References :

(1) I.N. Sneddon : Elements of Partial Differential Equation, Mc Graw Hill, International Editon, New York.

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

(3) Lawrence C. Evans: Partial Differential Equations, Vol. 19, AMS, 1998.

403 : 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, Hubbleôs law , Weyls Postulate, Steady State Cosmological models, Derivation of Roberson-Walker Metric, Further Properties.

Unit-III : Motion of particles and light rays in R-W model: Material particles, Radial motion of a particle, General motion, light rays. The red shift in R-W model , Hubblôs and Deceleration Parameters.

Unit-IV : Fundamental equation of dynamical cosmology: Density and pressure of present universe, the matter dominated era of the present universe, Friedmann models: closed model, Flat model, Open modelò

Unit-V : Relativistic stellar structure, simple stellar models- The interior Schwarschild solution, The field of a charged mass point

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. W eatherburn, Cambridge University Press, 1950.

404 : 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, Maxwellôs 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, Ferraroôs laws of isorotation.

Unit-V : Dynamical similarity , Buckingham p-theorem, Reynold number , Prandtôs 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, T ext Book of Fluid Dynamics, CBS Publishers, Delhi,

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 Y ork, 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.

405 : OPERATION RESEARCH-II (OPTIONAL)

Unit-I : Queing system, Basic characteristic of queuing system, Element of Queing system, Poisson and Non Poisson Queing system.

Unit-II : Games and strategies, Two Person Zero sum games, The maximum -minimum principle, games without saddle point, mixed strategies, Graphics solution of 2xn and mx2games, Dominance properties, general solution of mxn rectangular games.

Unit-III : Non-Linear Programming, Formulation, general NLLP, constrained optimization with equality constraints, with inequality constraints, saddle point problems.

Unit-IV : Non-Linear Programming method, Graphical solution, Kuhn-Tucker condition with non-negative constraints, Quadratic Programming, wolfeôs modified simplex method, Beals method.

Unit-V : Separable convex programming, geometric programming, Geometric -Arithmetic mean inequality, unconstrained and constrained geometric programming problems, complementation geometric programming.

Text Book :

(1) Kantiswarup, P .K.Gupta and Man Mohan, Operations Research, Sultan Chand & Sons, New Delhi- (2007)

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 ï An Introduction. Chand & company Ltd. New Delhi.

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

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

406: DIFFERENCE EQUATIONS-II

Unit-I : The Self-adjoint Second Order Linear Equations : Introduction, S turmian theory , Greenô s functions. Disconjugacy , the Riccati equations. Oscillation.

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

Unit-III : Discrete Calculation of Variation : Introduction. Necessary conditions. Suf ficient 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.

407: 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.

408: 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 ôs 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 Lieô s first and second theorems.

Text Books :

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

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

409 : 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 V on Newmann Algebra, Maximal Abelian Algebras.

Unit-IV : Abelian V on Newman Algebras. Cycling and Seperating vectors. Representation of Abelian V on Newmann Algebras, the L functional calculus. Connectedness of the Unitary group.

Unit-V : The Projection lattice. Kaplanskyôs formula. The centre of a V on Newmann Algebra. Various types of projections. Centrally orthogonal projections, type decomposition.

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

Reference Books:

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

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

410 : NON-COMMUTATIVE RINGS-II (OPTIONAL)

Unit-I : Division rings, tensor products and maximal subfields [x13,x 15 of [1]].

Unit-II : Polynomials over division rings. [x 16 of [1]].

Unit-III : Local rings, Semi local rings [x 19, x 20 of [1]].

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

Unit-V : Perfect and semiperfect rings. [x 23 of [1]].

T ext 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,

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