Shivaji University, Kolhapur
M.A./ M.Sc. Part-II (Regular & Distance Mode) To be Implanted from Academic Year – 2010 -2011

STRUCTURE OF M.A./ M.Sc. MATHEMATICS SEM.-III & IV

SEMESTER – III

Compulsory Papers

NMT :- 301 Functional Analysis
NMT :- 302 Advanced Discrete Mathematics

Any three from the following (Optional Papers)

NMT:- 303 Operation Research –I
NMT:- 304 Riemannian Geometry – I
NMT:- 305 Fluid Mechanics-I
NMT:- 306 Fuzzy Mathematics –I
NMT:- 307 Graph Theory
NMT:- 308 Number Theory
NMT:- 309 Algebraic Topology
NMT:- 310 Numerical Solutions of Partial Differential Equations

SEMESTER – IV

Compulsory Papers

NMT:- 401 Measure and Integration
NMT:- 402 Partial Deferential Equations

Any three from the following (Optional Papers)

NMT:- 403 Operation Research –II
NMT:- 404 Riemannian Geometry – II
NMT:- 405 Fluid Mechanics-II
NMT:- 406 Combinetorics
NMT:- 407 Automata Theory
NMT:- 408 Algebraic Number Theory
NMT:- 409 Artificial Neural Networks and Genetic Algorithms
NMT :- 410 Integral Equations

REVISED SYLLABUS FOR

M.A./M. Sc. Mathematics (Part II Sem III)

(Introduced from June 2010 onwards)

(Regular and external)

(i) Paper – NMT - 301

(ii) Title Of Paper: Functional Analysis

(iii) Specific Objectives:

The course aims at familiarizing students with the basic concepts, principles and methods of functional analysis and its applications. Functional analysis plays an important role in the applied sciences as well as in mathematics itself. Functional analysis develops the tools from calculus and linear algebra further to the more general setting where one has vector spaces comprising functions or general abstract infinite-dimensional vector spaces. Most of the problems from various application areas can be solved using the techniques of functional analysis. The basic objects studied in functional analysis are normed linear spaces and continuous maps between such spaces. This interplay between the algebraic and analytic setting gives rise to many interesting and useful results, which have a wide range of applicability to diverse mathematical problems

(iv) A brief note :-

Theorems and proofs are expected to be prepared from Topology and Modern Analysis by G.F.Simmons. This should be taken in to account for examination point of view.

(v) UNIT **No. of Lectures**

Unit I : **15**

Normed linear spaces, Banach spaces, Quotient spaces, continuous linear transformations, equivalent norms,the Hahn-Banach theorem and its consequences. Conjugate space and separability, second conjugate space. The natural embedding

of the normed linear space in its second conjugate space, Weak *topology on the conjugate space.

Unit II **15**

The open mapping Theorem, The closed graph theorem, The conjugate of an operator, The uniform bounded ness principle, Definition, examples and simple properties of Hilbert spaces.

Unit III **15**

Orthogonal complements, The projection theorem, orthogonal sets, The Bessels inequality, Fourier expansion and Parseval's equation, separable Hilbert spaces,The conjugate space, Riesz's theorem, The adjoint of an operator,

Unit IV **15**

self adjoint operators, Normal and unitary operators, Projections, Eigen values and eigenvectors of on operator on a Hilbert space,The determinants and spectrum of an operator, The spectral theorem on a finite dimensional Hilbert space.

(vi) Recommended Books :

1. G.F.Simmons : Topology and Modern Analysis, McGraw Hill (1963)

(vii) Reference Books

1.A.E.Taylor : Introduction to Functional analysis, John Wiley and sons (1958)

2. A.L.Brown and Page : Elements of Functional Analysis,
Van-Nastrand Reinehold com (1970)

3. B.V.Limaye : Functioned Analysis, New age international.

4. Erwin Kreyzig : Introduction to Functional Analysis with Applications, John Wiley and Sons.

5. J. B. Convey, Functional Analysis, Springer-Verlag.

6.. G.Bachman and Narici : Functional Analysis, Academic Press 1964

REVISED SYLLABUS FOR

M.A./M. Sc. Mathematics (Part II Sem III)

(Introduced from June 2010 onwards)

(Regular and external)

(i) Paper – NMT - 302

(ii) Title Of Paper: Advanced Discrete Mathematics

(iii) Specific Objectives:

Computer science uses an area of Mathematics as 'Discrete Mathematics'. The purpose of this course is to provide basic topics of Discrete Mathematics such as Graph Theory, Counting techniques and Boolean Algebra.

(iv) A brief note:-

Theorems and proofs are expected to be prepared from recommended books. This should be taken in to account for examination point of view.

(v) UNIT **No. of Lectures**

Unit – I (15)

Graph Theory: Definition, examples and properties, Simple graph, Graph isomorphism, Bipartite graphs, Complete Bipartite graph, regular graph, sub-graphs spanning sub-graph, Edge deleted sub-graph, Vertex deleted sub-graph, Union and intersection of two graphs, complements of a graph, self complementary graph, paths and cycles in a graph, Eccentricity, radius and diameter of a connected graph, Peterson graph, Wheel graph. Isomorphism of Graphs. First theorem of graph theory.

Unit – II (15)

The Matrix representation of a graph, Adjacency matrix and Incidence matrix of a graph, Definition and simple properties of a tree, bridges, spanning trees, Inclusion exclusion principle. Simple examples on Inclusion exclusion principle Pigeonhole principle, examples on Pigeonhole principle.

Unit – III (15)

Discrete numeric functions and sum and product of two numeric functions, generating functions, Linear recurrence relations with constant coefficients Particular solutions of linear recurrence relations, Total solutions.

Unit – IV (15)

1) Ordered sets and lattices Hasse diagrams of P.O.D. sets
2) Supremum and infimum
3) Isomorphic ordered sets, well-ordered sets
4) Lattices, Bounded lattices
5) Distributive lattices, Complements complemented lattices
6) Boolean algebra, Basic definitions, Basic theorems, duality, Boolean algebras as lattices

(vi) Recommended Reading:

1. Discrete Mathematics (second edition) by Seymon Lipschutz and Mark Lipson.Tata Mc Graw Hill Publishing Company Ltd. New Delhi
2. John Clark and Derek Holton : A first book at Graph Theory Applied Publishers Ltd.
3. C. T. Liu : Discrete Mathematics

(vii) Reference Books

1. Gorrett Birkhoff : Lattice Theory
2. Rich and Brualdi : Combinatorics
4. John C. Martin : Introduction to languages and the theory of computation TataMcGraw Hill Publishing Co,Ltd, New Delhi

REVISED SYLLABUS FOR

M.A./M. Sc. Mathematics (Part II Sem III)

(Introduced from June 2010 onwards)

(Regular and external)

(i) Paper – NMT - 303

(ii) Title Of Paper: Operation Research – I

(iii) Specific Objectives:

The main purpose of this course is to provide the students with basic concepts of Operation Research and specific methods of solving O.R. problems.

(iv) A brief note :- ()

(v) UNIT **No. of Lectures**

Unit – I **15 lectures**

Convex sets and their properties.Lines and hyper planes convex set Important Theorems, polyhedral convex set Convex combination of vectors, convex hull, Convex polyhedron, convex cone, simplex and convex function, General formulation of linear programming Matrix form of LP problem, definitions of standard LPP. Fundamental Theorem of linear programming.Simplex method, computational procedure of simplex method, problem of degeneracy and method to resolve degeneracy.

Unit- II **15 lectures**

Revised simplex method in standard form I, Duality in linear programming duality theorems, Integer linear programming, Gomory's cutting plane method, Branch and Bound method.

Unit – III **15 lectures**

Dynamic programming. Bellman's principle of Optimality, solution of problems with a finite number of stages . Application of dynamic programming in production, inventory control and linear programming.

Unit – IV **15 lectures**

Non linear programming unconstrained problems of maximum and minimum Lagrangian method Kuhn Tucker necessary and sufficient conditions, Wolfe's method, Beale's method

(vi) Recommended Reading:

1) S.D.Sharma : Operations Research, Kedar Nath Ram Noth and co.

(vii) Reference Books

1. Kanti Swarup , P.K.Gupta and Manmohan : Operations research, S.Chand & Co.

2. Hamady Taha : Operations Research :Mac Millan Co.

3. S.D.Sharma :Linear programming, Kedarnath,Romnath & Co.

4. S.D.Sharma : Nonlinear and Dynamic programming Kedar Nath Ram Nath and Co. Meerut

5. R.K.Gupta : Operations Research Krishna Prakashan Mandir, Meeru

6. G.Hadley : Linear programming, Oxford and IBH Publishing Co.

7. S.I.Gass : Linear Programming, Mc Graw Hill Book Co.

REVISED SYLLABUS FOR

M.A./M. Sc. Mathematics (Part II Sem III)

(Introduced from June 2010 onwards)

(Regular and external)

(i) Paper – NMT - 304

(ii) Title Of Paper: Riemannian Geometry -I

(iii) Specific Objectives:

(iv) A brief note :- ()

(v) UNIT **No. of Lectures**

Unit I: **(15 lectures)**

Space of N-dimensions, hypersurface, transformation of co-ordinates, summation convention, contravariant vectors, scalar invariants, covariant vectors, scalar product of two vectors, symmetric and skew symmetric tensors, contraction, composition of tensors, Quotient law, reciprocal symmetric tensor of the second rank, Quadratic forms, real quadratic forms, Quadratic differential forms.

Unit II: **(15 lectures)**

Riemannian metric, Riemannian space, length of a curve, magnitude of a vector, inclination of two vectors, orthogonal vectors, co-ordinate hypersurfaces, co-ordinate curves, field of normals to the hypersurface, n-ply orthogonal system of hypersurfaces, congruences of curves, orthogonal enuples, Principal directions for a symmetric covariant tensor of the second rank, Euclidean space of n- dimensions.

Unit III: **(15 lectures)**

Three index symbols, second derivatives of the x ' s with respect to x ' s , covariant derivative of a covariant and contravariant vectors, curl of a vector, derived vector in a given direction, covariant differentiation of tensors, divergence of a vector, Laplacian of a scalar invariants.

Unit IV: **(15 lectures)**

Curvature of a curve, Principal normal, Euler's conditions, Differential equations of geodesic, Geodesic co-ordinates, Riemannian co-ordinates, Geodesic form of the linear element. Parallel displacement of a vector of constant magnitude, parallelism for a vector of variable magnitude, subspaces of a Riemannian manifold, parallelism in a subspace. Tendency and divergence of vectors with respect to subspaces or enveloping space.

(vi) Recommended Reading:

1. C. E. Weatherburn: An Introduction to Riemannian Geometry and Tensor Calculus, Cambridge University Press, (1963)

2. L. P. Eisenhart: Riemannian Geometry, University Press Princeton (1926)

(vii) Reference Books

1. J.A. Schouten: Ricci Calculus, Springer Verlag, Berlin
2. T. Y. Thomas: Concepts from Tensor Analysis and differential Geometry, Academic Press, New York
3. Differential Geometry, O' Neil
4. Differential Geometry, Nirmal Prakash

REVISED SYLLABUS FOR

M.A./M. Sc. Mathematics (Part II Sem III)

(Introduced from June 2010 onwards)

(Regular and external)

(i) Paper – NMT - 305

(ii) Title Of Paper: Fluid Mechanics I

(iii) Specific Objectives:

(iv) A brief note :- ()

(v) Content of the syllabus:

Unit – I **15 lectures**

Introduction to continuum motion, fluid particle, inertial co-ordinates frames, continuum hypothesis, time derivatives, velocity and acceleration, steady and non-steady flow, stream line, path line, streak line, stream function, kinematics of vorticity and circulation, vortex line, vortex tube.

Unit-II **15 lectures**

Eulerian and Lagrangian method of description of fluids, Equation of continuity in Euler's form, equation of continuity in Euler's form, equation of continuity in Lagrange's form, equivalence of two forms of the equation of continuity, equation of continuity in curvilinear, spherical polar, cylindrical co-ordinates, Translation, rotation and deformation of fluid element, General motion of fluid element, boundary surface.

Unit-III **15 lectures**

Shear rate, strain rate tensor, principal co-ordinate systems, principal rate of extension, principal shear rates, strain rate tensor in different co-ordinate systems, stress tensor, normal stress, shearing stresses, symmetry of stress tensor, principal axes and principal values of stress tensor.

Unit- IV **15 lectures**

Conservation laws, equation of conservation of mass, equation of conservation of momentum, equation of moment of momentum, Bernoulli's equation, Bernoulli's equation for irrotational motion. General Theorems: Flow and circulation, irrotational motion, Kelvin's circulation theorem, Helmholtz's vorticity equation, Kelvin's minimum energy theorem

(vi) Recommended Books:

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

2)Bansi Lal , Hydrodynamics

(vii) References Books:-

1. W.H.Besaint and A.S.Ramsey : A Treatise of Hydromechanics, Part II, CBS Publishers, Delhi 1988.
2. G.K.Batchelor, : An Introduction to Fluid Mechanics, Foundation Books, New Delhi 1994.
3. A.J.Chorin and A.Marsden : A Mathematical Introduction of Fluid Dynamics, Springer-Verlag. New York 1993
4. H.Schlichting, Boundary Layer Theory, McGraw Hill Book Company New York 1979
5. A.D.Young: Boundary Layers, AIAA Eaucation Series, Washington DC 1989
6. S.W.Yuan, Foundations of Fluid Mechanics, Prentice Hall of India Private Limited, New Delhi 1976.

REVISED SYLLABUS FOR

M.A./M. Sc. Mathematics (Part II Sem III)

(Introduced from June 2010 onwards)

(Regular and external)

(i) Paper –NMT - 306

(ii) Title Of Paper: Fuzzy Mathematics - I

(iii) Specific Objectives:

To introduce the theory of fuzzy sets as a measure of uncertainty and ambiguity. Also to introduce the different operations on fuzzy sets.

(iv) A brief note :-

Theorems and proofs are expected to be prepared from Fuzzy sets and Fuzzy logic. Theory and applications, by Klir George and Bo Yuan,Prentice Hall of India Pvt. Ltd. New Delhi. 1997. This should be taken in to account for examination point of view

(v) UNIT **No. of Lectures**

Unit I **(15 lectures)**

1. The notion of fuzzy sets
2. Convex fuzzy set.
3. Basic concepts in fuzzy sets.
4. Properties of level cuts.

Unit II **(15 lectures)**

1. Representation of Fuzzy sets, Decomposition theorems.
2. Extension principle for fuzzy sets.
3. Operations on fuzzy sets, fuzzy complements .
4. Fuzzy intersection: t – norms.

Unit III **(15 lectures)**

1. Increasing and decreasing generators and their pseudo-inverses
2. Fuzzy union: t – co norms

3. Combinations of operations
4. Aggregation of operations

Unit IV **(15 lectures)**

1. Fuzzy numbers their characterizations.
2. Arithmetic operations on intervals of real numbers.
3. Arithmetic operations on fuzzy numbers
4. Lattice of fuzzy numbers

(vi) Recommended Books :

1) Klir George J. and Yuan Bo, Fuzzy sets and Fuzzy logic. Theory and applications, Prentice Hall of India Pvt. Ltd. New Delhi. 1997.

(vii) Reference Books

1) Kaufmann A and Gupta M.M., Introduction to Fuzzy arithmetics, Van Nostrand.
2) Lowen R., Fuzzy set theory, 1996
3) Zimmerman H.J. , Fuzzy set theory and its applications, 1997
4) Pedrycz W. and Gomide F., An Introduction to fuzzy sets Analysis and Design. The MIT Press, Massachusetts 1998.

REVISED SYLLABUS FOR

M.A./M. Sc. Mathematics (Part II Sem III)

(Introduced from June 2010 onwards)

(Regular and external)

(i) Paper – NMT - 307

(ii) Title Of Paper: Graph Theory

(iii) Specific Objectives:

(iv) A brief note :- ()

(v) UNIT **No. of Lectures**

Unit – I **(15)**

Trees and connectivity: Definitions and simple properties, Bridges, spanning trees, cut vertices and connectivity. Euler Tours

Unit – II **(15)**

Euler Tours and Homiltonian Cycles: Eulertours, the chinese postman problem, Hamiltonion graphs. The travelling salesman problem. Matchings : Matchings and Augmenting paths

Unit – III , **(15)**

The marriage problem The Personal Assignment problem, The Optimal Assignment problem, A chinese postman Problem, Postscript. Planer Graphs : Plane and Planar graphs, Eulers formula, Platonic bodies Kurotowskis theorem.

Unit – IV **(15)**

Non Homiltonian plane graphs. The dual of a plane graph. Colouring : Vertex coloring, vertex coloring algorithms, critical graphs, cliques, Edge coloring, map coloring. Directed graphs: Definition, Indegree and outdegree, Tournaments.traffic flow. Networks : Flows and Cuts, The Ford and Fulkerson Algorithm, Separating sets

(vi) Recommended Reading:

1) John Clark and Derec Haltan : A first look at graph theory,
Allied publishers Ltd.Bombay.

(vii) Reference Books

1) Douglas B.West : Introduction to Graph Theory Pearson Education .Asia.
2) F. Harary - Graph Theory, Narosa Publishing House (1989)
3) K.R.Parthsorthy : Basic Graph Theory, Tata McGraw Hill publishing Co.Ltd.New Delhi

REVISED SYLLABUS FOR

M.A./M. Sc. Mathematics (Part II Sem III)

(Introduced from June 2010 onwards)

(Regular and external)

(i) Paper – NMT - 308

(ii) Title Of Paper: Number Theory

(iii) Specific Objectives:

To introduce the students to the fascinating world of numbers . This course does not require very sophisticated tools of mathematics. There are so many open problems such as Goldbach Conjecture. Infact there are plenty of properties of integers which are yet to be explore.

(iv) A brief note :- ()

(v) UNIT **No. of Lectures**

Unit I: **(15 lectures)**

Review of divisibility : The division algorithm, G.C.D., Euclidean algorithm Diophontine equation ax + by = C.Primes and their distribution : Fundamental theorem of Arithmetic, The Goldbach Conjecture

Unit II: **(15 lectures)**

Congruences : Properties of Congruences, Linear congruences, Special divisibility tests. Fermats theorem : Fermats factorization method, Little theorem, Wilsons theorem Number theoretic functions : The functions τ and σ. The Mobius Inversion formula, The greatest integer function.

Unit III: **(15 lectures)**

Eulers Generalization of Fermats theorem : Euler's phi function, Euler's theorem, properties of phi function, An application to Cryptography. Primitive roots : The order of an integer modulo n

Unit IV: **(15 lectures)**

Primitive roots for primes, composite numbers having primitive roots, The theory of Indices. The Quadratic reciprocity law : Eulerian criteria, the Legendre symbol and its properties, quadratic reciprocity, quadratic reciprocity with composite moduli

(vi) Recommended Reading:

1. D.M.Barton : Elementary Number Theory, Universal book stall, New Delhi

(vii) Reference Books

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1. S.B.Malik : Baisc Number theory Vikas publishing House.
2. George E.Andrews : Number theory, Hindusthan Pub. Corp.(1972)
3. Niven, Zuckerman : An Introduction to theory of numbers. John Wiley & Sons
4. S. G. Telang , Number Theory, Tata Mc.Graw-Hill Publishing Co., New Delhi

REVISED SYLLABUS FOR

M.A./M. Sc. Mathematics (Part II Sem III)

(Introduced from June 2010 onwards)

(Regular and external)

(i) Paper – NMT - 309

(ii) Title Of Paper: Algebraic Topology

(iii) Specific Objectives:

(iv) A brief note :- ()

(v) UNIT **No. of Lectures**

Unit – I **(15)**

Geometric complexes and polyhedra : Orientation of Geometric Comlexes, incidence number, Problems. Simplicial homology groups : Chains, cycles

Unit – II **(15)**

Boundaries of homology groups, Examples of homology groups, The structure of homology groups, The Euler Poincare theorem, Problems. Eulers theorem, Pseudomanifolds and Homology groups of Sn.Simplicial Approximation : The simplicial mapping and its properties

Unit – III , **(15)**

The simplicial Approximation theorem, Induced homomorphisms on the homology groups, Brouwer's degree theorem, Problems. The Brouwer fixed point theorem and related topics, The Brower fixed point theorem, The Brouwer- Poincore theorem

Unit – IV **(15)**

.The fundamental Groups : Homotopic paths and fundamental groups, Problems. The covering Homotomy property for S1, The covering path property, The relation between H(K) and _1 (|k|) Covering spaces: Basic properties of covering spaces, Problems.

(vi) Recommended Books:

1) Croom F.H. : Basic concepts in Algebraic Topology, Springer Verlag 1978)

(vii) References Books:-

1) E.H.Spanier : Algebraic Topology, McGraw Hill, New York 1967

2) W.S.Massey : Algebraic Topology an introduction, Harcourt Broce and World Inc. N.Y.,

REVISED SYLLABUS FOR

M.A./M. Sc. Mathematics (Part II Sem III)

(Introduced from June 2010 onwards)

(Regular and external)

(i) Paper – NMT - 310

(ii) Title Of Paper: Numerical solutions of Partial Differential Equations

(iii) Specific Objectives:

(iv) A brief note :- ()

(v) UNIT **No. of Lectures**

Unit – I **(15)**

Classification of First order and second order partial differential equations. Finite difference approximations of partial derivates, order of approximations of first derivatives and second derivatives.

Unit – II **(15)**

Finite difference approximation of parabolic partial differential equation.
Explicit scheme, Crack Nicolson implicit method, two dimensional parabolic equation. Alternating direction implicit method.

Unit – III , **(15)**

Convergence and stability Descriptive treatment of convergence, local transaction error and consistency, descriptive treatment of stability, Analytical treatment of convergence, analytical treatment of stability.

Unit – IV **(15)**

Error Analysis, global rounding error, local truncation error, consistency or compatibility, relationship between convergence, stability and consistency, Lax's equivalence theorem.

Hyperbolic equation and characteristics, first order qualilnear equations, method of numerical integration along a characteristic , rectangular nets and finite difference methods for second order hyperbolic equation. Explicit methods and CFL condition finite difference representations for Laplace's equation.

(vi) Recommended Books:

1) G.D. Smith : Numerical solutions of partial differential equation : Finite difference method, oxford applied mathematics and computing series, second edition.

2) M.K. Jain : Numerical solutions of differential equation.

3) D.A. Anderson : J.C. Tannehill, Richard H. Pletcher : computational fluid mechanics and heat transfer, Mc Graw Hill 1984.

(vii) References Books:-

1) R.Mitchell & S.D.F Griffiths, The finite difference methods in partial differential equations , Wiley & sons N Y 1980.
2) J.W. Thomas , Numerical partial differential equations : Finite Difference Methods, Text in Applied Mathematics Vol,22 Springer Verlay NY 1999
3) K.W. Morton & D.F. Mayers , Numerical Solutions , An Introduction, second Edition,Camberidge University Press 2005.

REVISED SYLLABUS FOR

M.A./M. Sc. Mathematics (Part II Sem IV)

(Introduced from June 2010 onwards)

(Regular and external)

(i) Paper – NMT - 401

(ii) Title Of Paper: Measure and Integration

(iii) Specific Objectives:

1) To study the fundamentals of abstract measure on any space X and to define integration on this space X
2) To study the signed measure as a generalization of measure.
3) To introduced a measure on product space and to define integration on product space.
4) To study the L^p – spaces on general measure spaces.
5) To study outer measure and inner measure and their properties.

(iv) A brief note :-

Theorems and proofs are expected to be prepared from Real Analysis by H. L. Roydon. This should be taken in to account for examination point of view.

(v) UNIT **No. of Lectures**

Unit – I **(15)**

(1) Measure spaces : Finite, σ- finite and semifinite measures. Complete measure spaces,Locally measurable sets, Saturated measures.

(2) Measurable functions and their properties.

(3) Integration : Integration of nonnegative extended real valued functions, Fatou's lemma,

(4) Monotone convergence theorem, Lebesgue convergence theorem.

Unit – II **(15)**

(1) Signed measure : Positive sets, Negative sets and their properties.

(2) Hahn decomposition theorem, Jordan decomposition theorem, Total variation of a signed measure.

(3) The Radon –Nikodym theorem, Radon-Nikodym derivative.

(4) Lebesgue decomposition theorem.

Unit – III , (15)

(1) Product Measure : Measurable rectangles, Cross sections and their measurability.

(2) Fubini's theorem, Tonelli's theorem.

(3) The L^p spaces.

(4) Riesz representation theorem.

Unit – IV (15)

(1) Outer measure and measurability , Complete measure as a restriction of an outer measure

on a class of measurable sets.

(2) Measure on an algebra. Induced outer measure and its properties.

(3) Inner measure generated by measure on algebra.

(4) Properties of inner measure.

(vi) Recommended Books:

1. Royden, H. L. Real Analysis. (2002) 3rd edition . Prentice Hall of India, New Delhi.

(vii) References Books:-

(1) Berberian, S. K. Measure and Integration. Mc Millan, New York. (1965)

(2) Rana, I. K. An Introduction to Measure and Integration. Narosa Book Company(1997)

(3) Halmos, P. K. Measure Theory. Van Nostrand. (1950)

(4) Murkherjee, A and Pethoven, K. Real and Functional Analysis. Plenum Press. (1978)

(5) Friedmann, A. Fondations of Modern Analysis. Helf Rienhart and Winston. (1970),

(6) Zygmud, A. Measure and Integration. Marcel Dekker (1977)..

REVISED SYLLABUS FOR

M.A./M. Sc. Mathematics (Part II Sem IV)

(Introduced from June 2010 onwards)

(Regular and external)

(i) Paper – NMT - 402

(ii) Title Of Paper: : Partial Differential Equations

(iii) Specific Objectives:

To introduce to the students the main topics of partial differential equations, theory, basic methods and their applications to related areas.

(iv) A brief note :- ()

Theorems and proofs are expected to be prepared from T.A. Amaranath, An elementary course in partial differential equation. This should be taken into account from examination point of view.

(v) UNIT **No. of Lectures**

Unit – I **(15)**

First order partial differential equations, curves and surfaces. Classification of integrals, linear equations of first order, Pfafficum differential equations, compatible systems.

Unit – II **(15)**

Charpit's method, Jacobi's method Integral surface through a given curve, second order partial differential equations, classification of second order partial differential equations.

Unit – III , **(15)**

One dimensional wave equation vibrations of an infinite string A'Alembert's solution. Vibrations of string of finite length. Method of separation of variables. Uniqueness of solution, Laplace's equation, Boundary value problems. Maximum and minimum principles, The Cauchy problem.

Unit – IV **(15)**

Heat conduction equation.

Heat conduction – infinite rod case

Heat conduction – Finite rod case by method of separation of variables, Uniqueness of the solution,

Families of Equipotential surfaces, Kelvin's Inversion Theorem

(vi) Recommended Books:

1) T. Amarnath – An elementary course in Partial Differential Equations Narosa, Publishing House Second Edition

(vii) References Books:-

1) Fritz John, Partial Differential Equations
2) R. McOwen ,Partial Differential Equations Pearson Education
3) G. Folland – Partial Differential Equations, Prentice Hall, India 1998.

REVISED SYLLABUS FOR

M.A./M. Sc. Mathematics (Part II Sem IV)

(Introduced from June 2010 onwards)

(Regular and external)

(i) Paper – NMT - 403

(ii) Title of Paper: Operation Research II

(iii) Specific Objectives:

(iv) A brief note :- ()

(v) UNIT **No. of Lectures**

Unit – I **(15)**

Replacement Problems, Failure mechanism of items, Replacement policy for items whose maintenance cost increases with time and money values is constant, Group replacement of items that fail completely

Unit – II **(15)**

Inventory – Cost involved in inventory problems, variables in inventory problem, symbols in inventory concept of EOQ, Methods with calculus method

Model I (a) The economic lot size system with uniform demand.

Model I (b) Economic lot size with different rates of demand in different cycles.

Model I (c) Economic lot size with finite Rate of Replenishment.

(EOQ production model) EOQ model with shortages

Model II(a) The EOQ with constant rate of demand, scheduling, time constant.

Model II (c) The production lot size model with shortages.

Probabilistic inventory Models, Instantaneous demand, no set up cost model

Model VI(a) Discrete case

Model VI(b) continuous case

Problems on above models

Unit – III , **(15)**

Queuing Theory

Queuing systems , Queuing Problems: transient and steady states, traffic intensity . Probability distributions in Queuing systems Poisson process, Properties , Exponential process.

Model I : (M/M/I) : (∞ /FCFS),

Model II (a) : General Erlang queuing model.

Model II (b) : (M/M/I): (∞ / SIRO),

Model III : (M/M/I): (N/FCFS),

Model IV : (M/M/S): (∞ / FCFS)

Examples on all the above models. Problems

Unit – IV **(15)**

Information Theory : Communication process, Quantitative measure of information, A binary unit of information, measure of uncertainty of entropy, basic properties of entropy function (H) Joint and conditional entropies, Uniqueness theorem, Chanel capacity, efficiency and redundancy Encoding, Shannon Fano encoding procedure, PERT / CPM : Applications of PERT /CPM techniques, Network diagram, representations. Rules for constructing the Network diagram, determination of the critical path, Problems

(vi) Recommended Books:

S.D.Sharma : Operations Research Kedarnath and co. 1999

(vii) References Books:-

1) Hamdy Taha : Operations Research, Macmillan and Co.

2) J.K. Sharma : Operations Research, Macmillan India Ltd. 1999.

3) R.K.Gupta : Operations research, Krishna Prakashan Mandir, 1999

REVISED SYLLABUS FOR

M.A./M. Sc. Mathematics (Part II Sem IV)

(Introduced from June 2010 onwards)

(Regular and external)

(i) Paper – NMT - 404

(ii) Title Of Paper: Riemannian Geometry II

(iii) Specific Objectives:

(iv) A brief note :- ()

(v) UNIT **No. of Lectures**

Unit – I **(15)**

Ricci's coefficients of rotation, Curvature of congruence, Geodesic congruences, commutation formula for second derivatives along the arcs of the enuple. Coefficients of rotation, condition for normal congruence, curl of a congruence, congruences canonical with respect to a given congruence

Unit – II **(15)**

Curvature of a Riemannian Space: Curvature Tensor and Ricci tensor, covariant curvature tensor, The identity of Bianchi. Riemannian Curvature of a n V . Formula for Riemannian curvature. Theorem of Schur, Mean Curvature of a space for a given direction. Einstein space.

Unit – III , **(15)**

Hypersurfaces: Notations, unit normal, generalized covariant differentiation. Gauss's Formulae, second fundamental form. Curvature of a curve in a hypersurface. Normal curvature, Generalisation of Dupin's theorem. Principal normal curvature, Lines of curvature, conjugate directions and asymptotic directions in a hypersurface.

Unit – IV **(15)**

Tensor derivative of the unit normal. Derived vector. The equations of Gauss and Codazzi, Hypersurfaces with indeterminate lines of curvature. Totally geodesic hypersurfaces, family of hypersurfaces. Riemannian curvature of a hypersphere. Geodesic in a space of positive curvature. Gauss formulae for subspace, curvature of a curve in a subspace.

(vi) Recommended Books:

1. C. E. Weatherburn: An Introduction to Riemannian Geometry and Tensor Calculus, Cambridge University Press, (1963)

2. L. P. Eisenhart: Riemannian Geometry, University Press Princeton (1926)

(vii) References Books:-

1. J.A. Schouten: Ricci Calculus, Springer Verlag, Berlin

2. T. Y. Thomas: Concepts from Tensor Analysis and differential Geometry, Academic Press, New York

REVISED SYLLABUS FOR

M.A./M. Sc. Mathematics (Part II Sem IV)

(Introduced from June 2010 onwards)

(Regular and external)

(i) Paper – NMT - 405

(ii) Title Of Paper: Fluid Mechanics II

(iii) Specific Objectives:

(iv) A brief note :- ()

(v) UNIT **No. of Lectures**

Unit – I **(15)**

Motion in two dimensions, stream function in two dimensions, two dimensional irrotational incompressible flows, velocity derived from stream function, velocity in polar co-ordinates complex potential function, some potential flows, Blasius theorem, circle theorem.

Unit – II **(15)**

Sources, sinks and doublets in two dimensional flows, simple source in a uniform flow, doublet in a uniform flow, method of images, images of a source about a circular cylinder, image of a doublet in a plane, image of a doublet due to a circle.

Unit – III, **(15)**

Constitutive equation, viscosity, pressure, Newtonian hypothesis, Newtonian fluids, deviatoric stress, equation of conservation of momentum.

Unit – IV **(15)**

Naviour stokes equation, particular cases of Naviour stokes equation. Boundary layer theory, properties of Naviour stokes equation, two dimensional boundary layer equation. Displacement, momentum and energy thickness for two dimensional flow.

(vi) Recommended Books:

1) Rathy : An introduction to Fluid dynamics

(vii) References Books:-

1) G.K. Bathelor , An introduction to fluid Dynamics Cambridge University Press 2000.

2) Andrew Robert Paterson , A first course in Fluid dynamics , Cambridge University press 2001
3) Join Douglas , Janusz M. Gasiorek,Joh Swaffield Jack , Fluid Mechanics, Pearson Education Fifth Ed 2009.

REVISED SYLLABUS FOR

M.A./M. Sc. Mathematics (Part II Sem IV)

(Introduced from June 2010 onwards)

(Regular and external)

(i) Paper – NMT - 406

(ii) Title Of Paper: Combinatorics

(iii) Specific Objectives:

(iv) A brief note :- ()

(v) UNIT **No. of Lectures**

Unit – I **(15)**

1) The sum Rule and the product Rule
2) Permutations and combinations
3) The Pigeonhole Principle
4) Ramsey Numbers
5) Catalan Numbers
6) Stirling Numbers

Unit – II **(15)**

1) Generalized Permutation and combinations
2) Sequences and selections
3) The Inclusion – Exclusion principle, Sieve's formula
4) Derangements

5) System of Distinct Representatives (SDR)
6) Combinatorial Number theory

Unit – III, (15)

1) Rook- Polynomial
2) Ordinary and Exponential generating functions
3) Partitions of a positive integer
4) Recurrence Relations
5) Fibonacci sequence.

Unit – IV (15)

1) Group Theory in Combinatories
2) The Burnside Frobenius Theorem.
3) Permutation Groups and Their Cycle Indices
4) Polya's Enumeration and Theorems.

(vi) Recommended Books:

1) V.K. Balakrishnan
Schum's Outline of Theory and problems of combinatorics.
Schum's Outline Series Mc. Grew Hill INC

2) Richard A Broadly, Introductory combinatorics New Holland.

(vii) References Books:-

1) Alan Tucker – Applied Combinatorics. – John Willey Sons.

REVISED SYLLABUS FOR

M.A./M. Sc. Mathematics (Part II Sem IV)

(Introduced from June 2010 onwards)

(Regular and external)

(i) Paper – NMT - 407

(ii) Title Of Paper: Automata Theory

(iii) Specific Objectives:

(iv) A brief note :- ()

(v) UNIT **No. of Lectures**

Unit – I **(15)**

Semigroup Relation, Semigroup, Group, Permutation group, Products and homomorphisms, Machine and semigroup State machines and their semigroups

Unit – II **(15)**

Homomorphisms of state machines, Quotients, Coverings. Mealy machine, Decompositions.

Unit – III , **(15)**

Orthogonal partitions, Admissible partitions, Permutation-reset machines. Group machines

Unit – IV **(15)**

Connected transformation semigroups, Automorphism decompositions, Admissible subset system decomposition.

(vi) Recommended Books:

1) Holcombe M. L.: Algebraic automata theory, Cambridge University Press. (1982)

(vii) References Books:-

1) Arbib M. A. : Theory of abstract automata, Prentice Hall

2) Eilenberg, S. : Automata, Languages and machine

3) Ginburg A. : Algebraic theory of automata, Academic press.

REVISED SYLLABUS FOR

M.A./M. Sc. Mathematics (Part II Sem IV)

(Introduced from June 2010 onwards)

(Regular and external)

(i) Paper – NMT - 408

(ii) Title Of Paper: Algebraic Number Theory

(iii) Specific Objectives:

(iv) A brief note :- ()

(v) UNIT **No. of Lectures**

Unit – I **(15)**

Algebraic Numbers, Quadratic and cyclotomic fields : factorization into irreducibles

Unit – II **(15)**

Euclidean quadratic fields, prime factorization of ideals

Unit – III , **(15)**

Lattices, Minkowski's theorem, Geometric Representation of algebraic numbers

Unit – IV **(15)**

class groups and class numbers, computational methods

(vi) Recommended Books:

1) Algebraic Number Theory by I.N. Stewart & D.O. Tall, Academic press.
(Chapters 2 to 10)

(vii) References Books:-

1) Algebraic Number Theory : Mathematical Pamplet TIFR, Bombay

REVISED SYLLABUS FOR

M.A./M. Sc. Mathematics (Part II Sem IV)

(Introduced from June 2010 onwards)

(Regular and external)

(i) Paper – NMT - 409

(ii) Title Of Paper: Artificial Neural Networks and Genetic Algorithms

(iii) Specific Objectives:

(iv) A brief note :- ()

(v) UNIT **No. of Lectures**

Unit – I **(15)**

1) Fundamental concepts and Models of ANS. History of ANN, Biological Neuron, Artificial Neuron Mc-Culloch- Pitts Model, Neuron modeling for ANS.
2) Models of Artificial Neural Netwrok, Feed forward network, feedback network, Neural processing.
3) Learning and adaptation, learning as approximation or equilibria encoding, supervised and unsupervised learning.
4) Neural network learning rules – Hebbian, perceptron, Delta, Widrow – Hoff, correlation, winner- Take- All, outstar- learning rules.

Unit – II **(15)**

1) Single- layer perceptron classifiers.
   Classification model, features and decision regions linear machines and minimum distance classification.
2) Nonparametric training concept, Training and classification using discrete perceptron : Algorithm and perceptron convergence theorem.
3) Example – Single layer continuous perceptron network for linearly Separable classification, 1
4) Multicategory single layer perceptron networks

Unit – III , **(15)**

1) Multi layer Feed forward Networks :

Linearly nonseparable classifications, XOR, XNOR and corner isolation problems. Delta learning rule for multilayer perceptron, Generalized delta learning rule.

2) Feed forward recall and error back propagation training, examples Training errors,

3) Learning factors : Initial weights, cumulative weight adjustment versus incremental updating, steepness of the activation function, learning constants, momentum method, Network architectures necessary number of Hidden neurons.

4) Classifying and expert layered network: Character recognition application. Expert systems applications. Learning time sequences. Functional link networks.

Unit – IV **(15)**

GA and traditional methods

1) Introduction to GA, simple GA

2) G.A. Mathematical foundation

3) The fundamental theorem, two armed and K-armed bandit problem, similarity templates and hyperplanes

4) some applications of G.A. De Jong and function optimization, current applications.

(vi) Recommended Books:

1) Zurada J. M. : Introduction to Artificial Neural Systems. Jaico Publishing House, Mumabi (1997)

2) David E. Goldberg, Genetic Algorithm in Search, Pearson Education

(vii) References Books:-

1) Mehrotra , Ranka , Artificial Neural Networks, Penram International Publication.

2) Simon Haykins, Neural Networks, Pearson Publication

3) Anderson, James A., An Introduction to neural network, PHI, PVT Ltd., 1999.

REVISED SYLLABUS FOR

M.A./M. Sc. Mathematics (Part II Sem IV)

(Introduced from June 2010 onwards)

(Regular and external)

(i) Paper – NMT - 410

(ii) Title Of Paper: Integral Equations

(iii) Specific Objectives:

(iv) A brief note :- ()

(v) UNIT **No. of Lectures**

UNIT – I (15 Lectures)

Preliminary Concepts: Introduction, Some problems which give rise to integral equations, Classification of linear integral equations, Integro- differential equations, conversion of initial value problem to Volterra integral equation and boundary value problem to Fredholm integral equation, Definitions of separable (degenerate) kernels, Hermitian and symmetric Kernels, Leibnitz rule for derivative inside integration sign.

UNIT –II (15 Lectures)

Frdholm equations: Solutions of homogeneous Fredholm integral equations, Eigen values and Eigen functions. Orthogonality and reality of eigen values, Fredholm integral equations with separable, Hermitian and symmetric kernels, Iterated kernels and properties, Fundamental properties of eigen values and eigen functions for symmetric kernels.

UNIT – III (15 Lectures)

Operator method in the theory of integral equations, Truncated kernels and their properties, Hilbert – Schimdt Theorem Solutions of Fredholm integral equations by successive approximations – Resolvent or reciprocal kernel, Iterative method, Neumann series,

UNIT – IV (15 Lectures)

Green's function: Definition, Construction of Green's function and its use in solving boundary value problems, Volterra equations: Solutions by successive approximations – Resolvent kernel of Volterra equations, Neumann series, iterative method, Convolution type kernels. Applications of Laplace and Fourier transforms to solutions of Volterra integral equations, Solution of Volterra integral equations of first kind.

(vi) Recommended Reading:

1) Kanwal, R. P. Linear Integral Equation, Theory and Technique. (1971),Academic Press.
2) Chambers, L. G. Integral Equations, A Short Course. (1976), International Text Book Company.
3) Krasnov, M. A., et.al. Problems and exercises in Integral equations. (1971), Mir Publishers

(vii) Reference Books

1) Green, C. D. Integral Equation Methods. (1969), Thomas Nelson and sons.
2) Cochran, J. A. The Analysis of Linear Integral Equations.(1972), Mc Graw Hill Publcations

EQUVALANCE FOR SEMESTER - III

Sr.No.	Old Course	Sr.No.	New Course
1.	Functional Analysis	1.	Functional Analysis
2.	Advanced Discrete Mathematics	2.	Advanced Discrete Mathematics
3.	Linear Algebra	3.	-------
4.	Graph Theory	4.	Graph Theory
5.	Number Theory	5.	Number Theory
6.	Commutative Algebra- I	6.	-------
7.	Operation Research –I	7.	Operation Research –I
8.	Lattice Theory and Its Applications - I	8.	-------
9.	Distribution Theory	9.	-------
10.	Probability Theory	10.	-------
11.	Approximation Theory-I	11.	-------
12.	Topological Vector spaces	12.	-------
13.	Riemannian Geometry - I	13.	Riemannian Geometry - I
14.	General Relativity - I	14.	-------
15.	Geometric functional Analysis	15.	-------
16.	Advanced General Topology	16.	-------
17.	Fluid Mechanics-I	17.	Fluid Mechanics-I
18.	Fuzzy Mathematics	18.	Fuzzy Mathematics-I
19.	Integral Equations	19.	-------
20.	Theory of Computation	20.	-------
21.	Theory of ordinary Differential Equation	21.	-------
22.	Space Dynamics-I	22.	-------
23.	Magneto Fluid Dynamics-I	23.	-------
24.	Computer Science-I	24.	-------

EQUVALANCE FOR SEMESTER - IV

Sr.No.	Old Course	Sr.No.	New Course
1.	Measure and Integration		Measure and Integration
2.	Partial Deferential Equations		Partial Deferential Equations
3.	Combinetorics		Combinetorics
4.	Coding Theory		-------
5.	Commutative Algebra-II		-------
6.	Operation Research –II		Operation Research –II
7.	Lattice Theory and Its Applications – II		-------
8.	Transform Analysis		-------
9.	Mathematical Statistics		-------
10.	Approximation Theory-II		-------
11.	Harmonic Analysis		-------
12.	Riemannian Geometry -II		Riemannian Geometry -II
13.	General Relativity- II		-------
14.	Branch Algebra		-------
15.	Algebraic Topology		-------
16.	Automata Theory		Automata Theory
17.	Wavelet Analysis		-------
18.	Programming in C + +		-------
19.	Algebraic Number Theory		Algebraic Number Theory
20.	Numerical Analysis		-------
21.	Space Dynamics-II		-------
22.	Magneto Fluid Dynamics-II		-------
23.	Mechanics of Solids - II		-------