

## MATHEMATICS

Papers	Theory (M.M)	Continuous Comprehensive Evaluation (M.M.)	Practical (M.M.)	Total (M.M.)
<b>Paper I.</b> Advanced Abstract Algebra - I	40	10	-	50
<b>Paper II.</b> Real Analysis	40	10	-	50
<b>Paper III.</b> Topology - I	40	10	-	50
<b>Paper IV.</b> Complex Analysis - I	40	10	-	50
<b>Paper V. Optional (Any One) :-</b>				
(i) Differential Equations - I	40	10	-	50
(ii) Advanced Discrete Mathematics - I	40	10	-	50
(iii) Differential Geometry of Manifolds - I	40	10	-	50
(iv) Programming in C- I (Theory & Practical)	25	10	15	50
<b>Paper VI.</b> Comprehensive Viva-Voce				50
<b>Total</b>				<b>300</b>

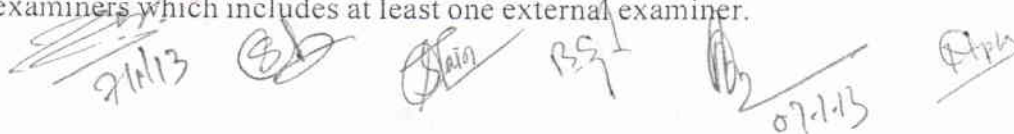
### COURSE STRUCTURE

M.A./M.Sc. SEMESTER - II, (Regular Students)

### MATHEMATICS

Papers	Theory (M.M)	Continuous Comprehensive Evaluation (M.M.)	Practical (M.M.)	Total (M.M.)
<b>Paper I.</b> Advanced Abstract Algebra - II	40	10	-	50
<b>Paper II.</b> Lebesgue Measure and Integration	40	10	-	50
<b>Paper III.</b> Topology - II	40	10	-	50
<b>Paper IV.</b> Complex Analysis - II	40	10	-	50
<b>Paper V. Optional (Any One) :-</b>				
(i) Differential Equations - II	40	10	-	50
(ii) Advanced Discrete Mathematics - II	40	10	-	50
(iii) Differential Geometry of Manifolds - II	40	10	-	50
(iv) Programming in C - II (Theory & Practical)	25	10	15	50
<b>Paper VI.</b> Comprehensive Viva-Voce				50
<b>Total</b>				<b>300</b>

Note : At the end of each Semester a Comprehensive Viva-Voce is to be conducted by a board of atleast three examiners which includes at least one external examiner.



**MATHEMATICS**

Papers	Theory (M.M)	Continuous Comprehensive Evaluation (M.M.)	Practical (M.M.)	Total (M.M.)
<b>Paper I.</b> Advanced Abstract Algebra - I	50	-	-	50
<b>Paper II.</b> Real Analysis	50	-	-	50
<b>Paper III.</b> Topology - I	50	-	-	50
<b>Paper IV.</b> Complex Analysis - I	50	-	-	50
<b>Paper V. Optional (Any One) :-</b>				
(i) Differential Equations - I	50	-	-	50
(ii) Advanced Discrete Mathematics - I	50	-	-	50
(iii) Differential Geometry of Manifolds - I	50	-	-	50
(iv) Programming in C- I (Theory & Practical)	35	-	15	50
<b>Paper VI.</b> Comprehensive Viva-Voce				50

**M.Sc./M.A. SEMESTER - II (Private Students)**

**MATHEMATICS**

Papers	Theory (M.M)	Continuous Comprehensive Evaluation (M.M.)	Practical (M.M.)	Total (M.M.)
<b>Paper I.</b> Advanced Abstract Algebra - II	50	-	-	50
<b>Paper II.</b> Lebesgue Measure and Integration	50	-	-	50
<b>Paper III.</b> Topology - II	50	-	-	50
<b>Paper IV.</b> Complex Analysis - II	50	-	-	50
<b>Paper V. Optional (Any One) :-</b>				
(i) Differential Equations - II	50	-	-	50
(ii) Advanced Discrete Mathematics - II	50	-	-	50
(iii) Differential Geometry of Manifolds - II	50	-	-	50
(iv) Programming in C - II (Theory & Practical)	35	-	15	50
<b>Paper VI.</b> Comprehensive Viva-Voce				50

Note : At the end of each Semester a Comprehensive Viva-Voce is to be conducted by a board of atleast three examiners which includes at least one external examiner.

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Regular	Private
Theory Marks : 40	Theory Marks : 50
C.C.E. Marks : 10	

M.Sc./M.A. Mathematics

**SEMESTER I**

**Paper I Advanced Abstract Algebra - I**

**Unit 1 -**

Automorphisms, Normal and subnormal series of groups, composition series, Jordan-Holder Theorem.

**Unit 2 -**

Commutator subgroup, Solvable series and Solvable groups, Central series and Nilpotent groups.

**Unit 3 -**

Extension fields, Roots of polynomials, Algebraic and transcendental extensions, Splitting fields, Separable and inseparable extensions.

**Unit 4 -**

Perfect fields, Finite fields, Algebraically closed fields.

**Unit 5 -**

Automorphism of extensions, Galois extensions, Fundamental theorem of Galois theory. Solution of polynomial equations by radicals, Insolvability of the general equation of degree 5 by radicals.

**Recommended Books :**

- [1] I. N. Herstein. Topics in algebra, Wiley Eastern Ltd. New Delhi, 1975.
- [2] Vivek Sahai and Vikas Bist, Algebra, Narosa Publishing House, 1999.
- [3] P.B. Bhattacharya, S.K. Jain and S.R. Nagpaul, Basic Abstract Algebra (2<sup>nd</sup> Edition), Cambridge University Press, Indian Edition, 1997.

**Reference Books :**

- [1] N. Jacobson, Basic Algebra, Vols. I & II, W.H. Freeman, 1980 (also published by Hindustan Publishing Company).
- [2] S. Lang, Algebra, Addison-Wesley.
- [3] I.S. Luthar and I.B.S. Passi, Algebra, Vol. I - Groups, Vol. II - Rings, Narosa Publishing House (Vol. I - 1996, Vol. II - 1999).

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Regular	Private
Theory Marks : 40	Theory Marks : 50
C.C.E. Marks : 10	

M.Sc./M.A. Mathematics

SEMESTER I

Paper II Real Analysis

Unit 1 -

Definition and existence of Riemann-Stieltjes integral, Properties of integral, integration and differentiation, the fundamental theorem of Calculus.

Unit 2 -

Integration of vector valued functions, Rectifiable curves. Rearrangement of terms of a series, Riemann's theorem. Sequences and series of functions, pointwise and uniform convergence.

Unit 3 -

Cauchy criterion for uniform convergence, Weierstrass M-test, Abel's and Dirichlet's test for uniform convergence, uniform convergence and continuity, uniform convergence and Riemann-Stieltjes integration, uniform convergence and differentiation, Weierstrass approximation theorem,

Unit 4 -

Power series, Uniqueness theorem for power series, Abel's theorem, Functions of several variables, linear transformations, Derivatives in an open subset of  $\mathbb{R}^n$ , chain rule, partial derivatives, interchange of the order of differentiation, derivatives of higher orders. Taylor's theorem,

Unit 5 -

Inverse function theorem, Implicit function theorem, Jacobians, Lagrange's multiplier method, Differentiation of integrals, partitions of unity, Differential forms, Stoke's theorem.

**Recommended Books :**

- [1]. Walter Rudin, Principles of Mathematical Analysis (3<sup>rd</sup> edition), McGraw-Hill, Kogakusha, 1976, International Student edition.

**Reference Books :**

- [1] T.M. Apostol, Mathematical Analysis, Narosa Publishing House, New Delhi, 1985.  
 [2] H.L. Royden, Real Analysis, Macmillan Publishing Co. Inc., 4<sup>th</sup> Edition, New York, 1993

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M.Sc./M.A. Mathematics

**SEMESTER I**

**Paper III Topology - I**

**Unit 1 -**

Countable and Uncountable sets. Infinite sets and the Axiom of Choice. Cardinal numbers and its arithmetic. Schroeder-Bernstein theorem. Cantor's theorem and the continuum hypothesis. Zorn's lemma. Well - ordering theorem.

**Unit 2 -**

Defintion and examples of topological spaces. Closed sets, Closure. Dense subsets. Neighbourhoods. Interior, exterior and boundary. Accumulation points and derived sets.

**Unit 3 -**

Bases and sub bases. Subspaces and relative topology, Product Topology, Metric Topology, Continuous functions and homomorphism.

**Unit 4 -**

First and Second Countable spaces. Covering and Lindelof's spaces. Separable spaces. second countability and Separability.

**Unit 5-**

Connected spaces, connectedness on real line, components, Path connectedness, locally connected spaces.

**Recommended Books :**

[1] James R. Munkres, Topology : A First Course, Prentice Hall of India Pvt. Ltd. New Delhi, 2000.

**Reference Books :**

- [1] K.D. Joshi, Introduction to General Topology, Willey Eastern Limited, 1983.
- [2] George F. Simmons, Introduction to Topology and Modern Analysis, McGraw-Hill Book Company, 1963.
- [3] J. Dugundji, Topology, Allyn and Bacon, 1966 (Reprinted in India by Prentice-Hall of India Pvt. Ltd.)1111444555566
- [4] N. Bourbaki, General Topology part-I (Transl.) Addison Wesley Reading 1966.
- [5] B. Mendelson, Introduction to Topology, Allyn & Becon, Inc., Boston, 1962.
- [6] E.H. Spanier, Algebraic Topology, McGraw-Hill, New York, 1966.
- [7] J.L. Kelley, General Topology, Van Nostrand, Reinhold Co., New York, 1995.
- [8] M.J. Mansfield, Introduction to Topology, D.Van Nostrand Co. Inc., Princeton, N.J. 1963.

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Regular	Private
Theory Marks : 40	Theory Marks : 50
C.C.E. Marks : 10	

M.Sc./M.A. Mathematics  
SEMESTER I

Regular	Private
Theory Marks : 40	Theory Marks : 50
C.C.E. Marks : 10	

Paper IV. Complex Analysis

Unit 1 -

Complex integration. Cauchy-Goursat Theorem. Cauchy's integral Formula. Higher Order derivatives.

Unit 2 -

Morera's Theorem. Cauchy's inequality and Liouville's theorem. The fundamental theorem of Algebra. Taylor's theorem.

Unit 3 -

Maximum modulus principle. Schwarz lemma. Laurent's series. Isolated singularities. Meromorphic functions. The argument principle. Rouché's theorem inverse function theorem.

Unit 4 -

Möbius Transformations. Fixed Points, Cross Ratio, Bilinear transformations, their properties and classifications. Definitions and Examples of Conformal mappings.

Unit 5 -

Residues. Cauchy's residue theorem. Evaluation of integrals. Branches of many valued functions with special reference to  $\arg z$ ,  $\log z$  and  $z^a$ .

**Recommended Books :**

- [1] J.B. Conway, Functions of one Complex variable, Springer-Verlag, International Student Edition, Narosa Publishing House, 1980.
- [2] Brijendra Singh, Varsha Karanjgoakar and R. S. Chandel, Complex Analysis, Gaura Pustak Sadan, Agra - 7.

**Reference Books :**

- [1] S. Ponnusamy, Foundations of Complex Analysis, Narosa Publishing House, 1997.
- [2] L.V. Ahlfors, Complex Analysis, McGraw-Hill, 1979.
- [3] B. Singh, Varsha Karanjgoakar and R.S.Chandel, Complex analysis, Golden Valley Publications.

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Regular	Private
Theory Marks : 40	Theory Marks : 50
C.C.E. Marks : 10	

M.Sc./M.A. Mathematics

SEMESTER I**Optional Paper V (i) Differential Equations - I****Unit 1 -**

Initial value Problem and the equivalent integral equation,  $m^{\text{th}}$  order equation in  $d$  - dimension as a first order system, concepts of local existence, existence in the large and uniqueness of solutions with examples.

**Unit 2 -**

Basic Theorems- Ascoli- Arzela Theorem. A theorem on convergence of solutions of a family of initial value problems.

**Unit 3 -**

Picard-Lindelof theorem-Peano's existence theorem and corollary. Maximal intervals of existence. Extension theorem and corollaries. Kamke's convergence theorem. Kneser's theorem (Statement only)

**Unit 4 -**

Differential inequalities and Uniqueness - Gronwall's inequality. Maximal and Minimal Solutions. Differential inequalities. A theorem of Winter. Uniqueness Theorems. Nagumo's and Osgoods's criteria.

**Unit 5 -**

Egres points and Lyapunov functions. Successive approximations.

Linear Differential Equations - Linear systems, Variation of Constants, reduction to smaller systems. Basic inequalities, Constant coefficients. Floquet theory. Adjoint systems, Higher Order equations.

**Recommended Books :**

[1] P. Hartman, Ordinary Differential Equations, John Wiley (1964).

**Reference Books :**

[1] W.T. Reid, Ordinary Differential Equations, John Wiley & Sons, NY (1971).

[2] E.A. Coddington and N. Levinson, Theory of Ordinary Differential Equations, Mc Graw Hill, NY (1955).

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Regular	Private
Theory Marks : 40	Theory Marks : 50
C.C.E. Marks : 10	

M.Sc./M.A. Mathematics

SEMESTER I

**Optional Paper V (ii) Advanced Discrete Mathematics - I**

**Unit 1 -**

Semigroups & Monoids - Definitions and examples of Semigroups and Monoids (including those pertaining to concatenation operation). Homomorphism of semigroups and Monoids. Congruence relation and Quotient Semigroups. Subsemigroup and submonoids. Direct products. Basic Homomorphism Theorem.

**Unit 2 -**

Lattices - Lattices as partially ordered sets. Their properties. Lattices as Algebraic systems. sublattices, Direct products, and Homomorphisms. Some Special Lattices e.g., Complete, Complemented and Distributive Lattices.

**Unit 3 -**

Boolean Algebras - Boolean Algebras as Lattices. Various Boolean Identities. The Switching Algebra example. Subalgebras, Direct products and Homomorphisms. join-irreducible elements. Atoms and Minterms. boolean forms and Their Equivalence. Minterm Boolean forms, Sum of products Canonical forms. Minimization of Boolean Functions. Applications of boolean Algebra to Switching Theory- ( using AND, OR & NOT gates). the Karnaugh Map method.

**Unit 4 -**

Graph Theory- Definition of (undirected) Graphs, Paths, Circuits Cycles & Subgraphs. Induced Subgraphs. Degree of a vertex. Connectivity. Planar Graphs and their properties. Trees.

**Unit 5 -**

Eulers Formula for connected Planar Graphs. Complete & Complete Bipartite Graphs. Kuratowskis Theorem ( statement only) and its use . Spanning trees, cut-sets. Fundamental Cut- Sets, and Cycles. minimal Spanning trees and Kruskals Algorithm. Matrix Representations of Graphs.

**Recommended Books :**

- [1] J.P.Trembly & R.Manohar, Discrete mathematical Structures with Applications to Computer Science, McGraw Hill Book Co. 1997.
- [2] N. Deo, Graph Theory with applications to Engineering and Computer Sciences, Prentice Hall of India.

**Reference Books :**

- [1] J.L.Gersting, Mathematical Structures for Computer Science, (3rd edition), Computer Science Press, New york.
- [2] Seymour Lipschutz, Finite Mathematics (International edition 1983) McGraw- Hill Book Company, Newyork.
- [3] S.Wiitala, Discrete Mathematics - A Unified Approach, MC graw- Hill Book Co.
- [4] J.E.Hopcroft and J.D. Ullman, Introduction to Automata Theory Languages & Computation Narosa Publishing House.
- [5] B. Singh, R.S.Chandel and Akhilesh Jain, Advanced Discrete Mathematics, Golden Valley Publications.

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M.Sc./M.A. Mathematics  
SEMESTER I

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Theory Marks : 40 C.C.E. Marks : 10	Theory Marks : 50

Optional Paper V (iii) **Differential Geometry of Manifolds - I**

**Unit I -**

Definition and examples of differentiable manifolds. Tangent spaces. Jacobian map. One parameter group of transformations.

**Unit II -**

Lie derivatives. Immersions and Embeddings. Distributions. Exterior algebra. Exterior derivative.

**Unit III -**

Topological Groups. Lie groups and Lie algebras. Product of two Lie groups.

**Unit IV -**

One parameter subgroup and exponential maps. Examples of Lie groups.

**Unit V -**

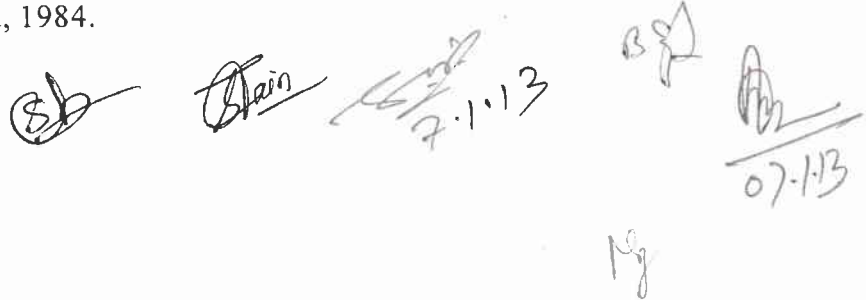
Homomorphism and Isomorphism. Lie transformation groups. General Linear groups. Principal fibre bundle. Linear frame bundle.

**Recommended Books :**

- [1] B.B. Sinha, An Introduction to Modern differential Geometry, Kalyani Publishers, New Delhi, 1982.
- [2] K. Yano and M. Kon, Structure of Manifolds, World Scientific Publishing Co. Pvt. Ltd., 1984.

**References Books :**

- [1] R.S. Mishra, A Course in tensors with applications to Riemannian Geometry, Pothishala (Pvt.) Ltd., 1965.
- [2] R.S. Mishra, Structures on a differentiable manifold and their applications, Chandrama Prakashan, Allahabad, 1984.


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Max. Marks 50

M.Sc./M.A. Mathematics

SEMESTER I

Regular	Private
Theory Marks : 25	Theory Marks : 35
C.C.E. Marks : 10	Practical Marks:15
Practical Marks:15	

कक्षा Class : M.Sc. (Mathematics)  
सेमेस्टर Semester : I  
विषय समूह का शीर्षक Title of Subject : **Programming in C (Theory and Practical) I**  
Group : V (iv)  
प्रश्न पत्र कं. Paper No. : iv  
अनिवार्य/ वैकल्पिक Compulsory/ Optional : **Optional**

Unit-1

An overview of programming languages

Unit-2

Classification. C Essentials - Programs development, Functions

Unit-3

Anatomy of a Function. Variables and Constants Expressions. Assignment Statements.  
Formatting Source files Continuation Character. the Preprocessor.

Unit-4

Scalar Data types - Declarations, Different Types of integers. Different kinds of Integer  
Constants Floating - point type Initialization

Unit-5

mixing types Explicit conversions - casts. Enumeration Types. the void data type , Typedefs.  
Pointers.

Reference Books:

- (1) Samuel P. Harkison and Gly L Steele Jr. C; A Reference manual , 2an Edition Prentice hall 1984.
- (2) Brain W Kernigham & Dennis M Ritchie the C Programmed Language 2nd Edition (ANSI features), Prentice Hall 1989.

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Regular	Private
Theory Marks : 40	Theory Marks : 50
C.C.E. Marks : 10	

M.Sc./M.A. Mathematics

**SEMESTER II**

**Paper I Advanced Abstract Algebra - II**

**Unit 1 -**

Introduction to Modules, Examples, Sub-modules and direct sums, Examples of sub-modules, Quotient Modules, R-Homomorphism and Examples of R-Homomorphism ,

**Unit 2 -**

Finitely generated modules. Cyclic modules, Simple modules, Schur's Lemma, Free modules .

**Unit 3 -**

Noetherian and Artinian modules and rings, Hilbert basis theorem.

**Unit 4 -**

Uniform modules, primary modules and Noether-Lasker theorem.

**Unit 5 -**

Algebra of linear transformations, Characteristic roots, Similarity of linear transformations. Invariant subspaces, Reduction to triangular forms, Nilpotent transformations, Index of nilpotency, Invariants of a nilpotent transformation, The primary decomposition theorem.

**Recommended Books :**

- [1] I. N. Herstein. Topics in algebra, Wiley Eastern Ltd..New Delhi, 1975.  
[2] Vevek Sahai and Vikas Bist, Algebra, Narosa Publishing House, 1999.

**Reference Books :**

- [1] P.B. Bhattacharya, S.K. Jain and S.R..Nagpaul, Basic Abstract Algebra (2<sup>nd</sup> Edition). Cambridge University Press, Indian Edition, 1997. .  
[2] S. Kumaresan, Linear Algebra - A geometric approach, Prentice Hall of India, Ltd.

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Regular	Private
Theory Marks : 40	Theory Marks : 50
C.C.E. Marks : 10	

M.Sc./M.A. SEMESTER - II

**Paper II Lebesgue Measure and Integration****Unit 1 -**

Lebesgue outer measure. Measurable sets. Regularity. Measurable functions. Borel and Lebesgue measurability. Non-measurable sets.

**Unit 2 -**

Integration of Non-negative functions. The General integral. Integration of Series. Reimann and Lebesgue integrals.

**Unit 3 -**

The Four derivatives. Functions of bounded variation. Lebesgue Differentiation Theorem. Differentiation and Integration.

**Unit 4 -**

The  $L^p$  spaces, Convex functions, Jensen's inequality, Hölder and Minkowski inequalities. Completeness of  $L^p$ .

**Unit 5 -**

Dual of space, Convergence in Measure, Uniform convergence and Almost uniform convergence.

**Recommended Books :**

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

**Reference Books :**

- [1]. Walter Rudin, Principles of Mathematical Analysis (3<sup>rd</sup> edition), McGraw-Hill, Kogakusha, 1976, International Student edition.
- [2] H.L. Royden, Real Analysis, Macmillan Publishing Co. Inc., 4<sup>th</sup> Edition, New York, 1993
- [3] Inder K. Rana, An Introduction to Measure and Integration, Narosa Publishing House, 1997.
- [4] P.R. Halmos, Measure Theory, Van Nostrand, Princeton, 1950.
- [5] P.K. Jain and V.P. Gupta, Lebesgue Measure and Integration, New Age International (P) Limited Published New Delhi, 1986 (Reprint 2000).

Max. Marks 50

Regular	Private
Theory Marks : 40	Theory Marks : 50
C.C.E. Marks : 10	

M.Sc./M.A. SEMESTER - II

Paper III Topology - II

Unit 1 -

Separation axioms  $T_0, T_1, T_2, T_3^{1/2}, T_4$  their characterization and basic properties. Urysohn's lemma. Tietze extension theorem.

Unit 2 -

Compactness. Continuous functions and compact sets. Basic properties of compactness. Compactness and finite intersection property. Sequentially and countably compact sets. Local Compactness and one point compactification. Stone-Cech compactification.

Unit 3 -

Tychonoff product, Projection maps. Separation axioms and product spaces. Connectedness and product spaces. Compactness and product spaces (Tychonoff Theorem). Embedding lemma and Tychonoff embedding.

Unit 4 -

Nets and Filters. Topology and Convergence of nets. Hausdorffness and nets. Compactness and nets. Filters and their convergence. Canonical way of converting nets to filters and vice versa. Ultrafilters and compactness.

Unit 5 -

The fundamental group and covering spaces-Homotopy of paths. The fundamental group. Covering spaces. The fundamental group of the circle and the fundamental theorem of algebra.

**Recommended Books :**

- [1] James R. Munkres, Topology : A First Course, Prentice Hall of India Pvt. Ltd. New Delhi, 2000.
- [2] K.D. Joshi, Introduction to General Topology, Willey Eastern Limited, 1983.

**Reference Books :**

- [1] George F. Simmons, Introduction to Topology and Modern Analysis, McGraw-Hill Book Company, 1963.
- [2] J. Dugundji, Topology, Allyn and Bacon, 1966 (Reprinted in India by Prentice-Hall of India Pvt. Ltd.)
- [3] N. Bourbaki, General Topology part-I (Transl.) Addison Wesley Reading 1966.
- [4] B. Mendelson, Introduction to Topology, Allyn & Becon, Inc., Boston, 1962.
- [5] E.H. Spanier, Algebraic Topology, McGraw-Hill, New York, 1966.
- [6] J.L. Kelley, General Topology, Van Nostrand, Reinhold Co., New York, 1955.
- [7] M.J. Mansfield, Introduction to Topology, D. Van Nostrand Co. Inc., Princeton. N.J. 1963.

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Max. Marks 50

Regular	Private
Theory Marks : 40	Theory Marks : 50
C.C.E. Marks : 10	

M.Sc./M.A. SEMESTER - II

Paper IV Complex Analysis - II

Unit 1 -

Weierstrass' factorisation theorem. Gamma function and its properties. Riemann Zeta function. Riemann's functional equation.

Unit 2 -

Runge's theorem. Mittag-Leffler's theorem. Analytic Continuation. Uniqueness of direct analytic continuation. Uniqueness of analytic continuation along a curve. Power series method of analytic continuation.

Unit 3 -

Schwarz Reflection principle. Monodromy theorem and its consequences. Harmonic functions on a disk.

Unit 4 -

Harnack's inequality and theorem. Dirichlet problem. Green's function. Canonical products. Jensen's formula. Poisson - Jensen formula. Hadamard's three circles theorem. Order of an entire function. Exponent of Convergence. Borel's theorem. Hadamard's factorization theorem.

Unit 5 -

The range of an analytic function. Bloch's theorem. The little Picard theorem. Schottky's theorem. Montel Caratheodary and great Picard theorem. Univalent function. Bieberbach conjecture and the  $1/4$  theorem.

**Recommended Books :**

- [1] J.B. Conway, Functions of one Complex variable, Springer-Verlag, International Student Edition, Narosa Publishing House, 1980.

**Reference Books :**

- [1] S. Ponnusamy, Foundations of Complex Analysis, Narosa Publishing House, 1997.  
[2] H.A. Priestly, Introduction to complex analysis, Clarendon Press, Oxford, 1990.  
[3] D. Sarason, Complex Function Theory, Hindustan Book Agency, Delhi, 1994.  
[4] E.C. Titchmarsh, The Theory of Functions, Oxford University Press, London.  
[5] L.V. Ahlfors, Complex Analysis, McGraw-Hill, 1979.  
[6] Walter Rudin, Real and Complex Analysis, McGraw-Hill Book Co., 1966.  
[7] S. Saks and Zygmund, Analytic Functions, Monografie matematyczne, 1952.  
[8] B. Singh, Varsha Karanjgoakar and R.S.Chandel, Complex analysis, Golden Valley Publications.

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Max. Marks 50

Regular	Private
Theory Marks : 40	Theory Marks : 50
C.C.E. Marks : 10	

M.Sc./M.A. SEMESTER - II

Optional Paper V (i) Differential Equations - II

Unit 1 -

Dependence on initial conditions and parameters, preliminaries. Continuity. Differentiability. Higher Order Differentiability.

Unit 2 -

Poincare-Bendixson Theory - Autonomous Systems. Umlanfsatz. Index of a stationary point.

Poincare-Bendixson Theorem. Stability of periodic solutions, rotation points, foci, nodes and saddle points.

Unit 3 -

Linear second order equations-preliminaries. Basic facts. Theorems of Sturm. Sturm-Liouville Boundary Value Problems. Number of Zeros. Nonoscillatory equations and principal solutions. Nonoscillation theorems.

Unit 4 -

Use of Implicit function and fixed point theorems- periodic solutions. Linear equations. Nonlinear problems.

Unit 5 -

Second Order Boundary Value Problems- Linear Problems. Nonlinear problems. A priori bounds.

**Recommended Books :**

[1] P. Hartman, Ordinary Differential Equations, John Wiley (1964).

**Reference Books :**

[1] W.T. Reid, Ordinary Differential Equations, John Wiley & Sons, NY (1971).

[2] E.A. Coddington and N. Levinson, Theory of Ordinary Differential Equations, Mc Graw Hill, NY (1955).

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Max. Marks 50

M.Sc./M.A. SEMESTER - II

Regular	Private
Theory Marks : 40	Theory Marks : 50
C.C.E. Marks : 10	

**Optional Paper V (ii) Advanced Discrete Mathematics - II**

**Unit 1 -**

Directed Graphs. Indegree and Outdegree of a Vertex. Weighted Undirected Graphs. Dijkstra's Algorithms. Strong connectivity and Warshall's Algorithms. Directed Trees. Search Trees. Tree Traversals.

**Unit 2 -**

Introductory Computability Theory- Finite State Machines and their Transition Table Diagrams. Equivalence of Finite State Machines. Reduced Machines. Homomorphism. Finite Automata. Acceptors.

**Unit 3 -**

Non- deterministic finite Automata and equivalence of its power to that of Deterministic Finite Automata Moore and Mealy Machines.

**Unit 4 -**

Turing Machine and Partial Recursive Functions.

Grammars and Languages - Phrase- Structure Grammars. Rewriting Rules. Derivations.

**Unit 5 -**

Sentential forms. Language generated by a Grammar . Regular , Context -Free , and Context Sensitive Grammars and Languages Regular Sets, Regular Expressions and the Pumping Lemma Kleenes Theorem.

Notions of Syntax Analysis. Polish Notations Conversion of Infix Expressions to Polish Notations. The Reverse Polish Notation.

**Recommended Books :**

- [1] J.P.Tremby & R.Manohar, Discrete mathematical Structures with Applications to Computer Science, McGraw Hill Book Co. 1997.
- [2] N.Deo, Graph Theory with applications to Engineering and Computer Sciences, Prentice Hall of India.

**Reference Books :**

- [1] J.L.Gersting, Mathematical Structures for Computer Science, (3rd edition), Computer Science Press, New York.
- [2] Seymour Lipschutz, Finite Mathematics (International edition 1983) McGraw- Hill Book Company, New York.
- [3] S.Wiitala, Discrete Mathematics - A Unified Approach, McGraw- Hill Book Co.
- [4] J.E.Hopcroft and J.D. Ullman, Introduction to Automata Theory Languages & Computation Narosa Publishing House.
- [5] B. Singh, R.S.Chandel and Akhilesh Jain, Advanced Discrete Mathematics, Golden Valley Publications.



Max. Marks 50

Regular	Private
Theory Marks : 40	Theory Marks : 50
C.C.E. Marks : 10	

M.Sc./M.A. SEMESTER - II

**Optional Paper V (iii) Differential Geometry of Manifolds - II**

**Unit I -**

Associated fibre bundle. Vector bundle. Induced bundle. Bundle homomorphisms.

**Unit II -**

Riemannian manifolds. Riemannian connection. Curvature tensors. Sectional Curvature. Schur's theorem.

**Unit III -**

Geodesics in a Riemannian manifold. Projective curvature tensor. Conformal curvature tensor.

**Unit IV -**

Submanifolds & Hypersurfaces. Normals. Gauss' formulae. Weingarten equations. Lines of Curvature. Generalised Gauss and Mainardi-Codazzi equations.

**Unit V -**

Almost Complex manifolds. Nijenhuis tensor. Contravariant and covariant almost analytic vector fields. F-connection.

**Recommended Books :**

- [1] B.B. Sinha, An Introduction to Modern differential Geometry, Kalyani Publishers, New Delhi, 1982.
- [2] K. Yano and M. Kon, Structure of Manifolds, World Scientific Publishing Co. Pvt. Ltd., 1984.

**References Books :**

- [1] R.S. Mishra, A Course in tensors with applications to Riemannian Geometry, Pothishala (Pvt.) Ltd., 1965.
- [2] R.S. Mishra, Structures on a differentiable manifold and their applications. Chandrama Prakashan, Allahabad, 1984.

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Max. Marks 50

Regular	Private
Theory Marks : 25 C.C.E. Marks : 10 Practical Marks: 15	Theory Marks : 35 Practical Marks: 15

M.Sc./M.A. SEMESTER - II

**Optional Paper V (iv) Programming in C (Theory & Practical) -II**

Unit-1

Control Flow - Conditional Branching, the Switch Statement. looping. nested loops

Unit-2

The Break and Continue statement . the goto statement infinite loops.

Unit-3

Operators and Expressions - Precedence and associativity. Unary plus and Minus operators. Binary Arithmetic operators arithmetic assignment operators. Increment and decrement operators. Comma Operator Relational operators logical operators bit- Manipulation operators Bitwise assignment operators. Cast operators size of Operators , Conditional Operators , memory operator.

Unit-4

Arrays and multidimensional Arrays. Storage Classes - fixed vs. Automatic Duration Scope. global variable

Unit-5

The Register Specifier Structures and Unions.

Recommended Books:

- (1) Peter A Darnell and Philip E. Margolis, C; A Software Engineering Approched narosa Publishing House (Springer International Student Edition) 1993.

Reference Books:

- (1) Samuel P. Harkison and Gly L Steele Jr. C; A Reference manual , 2an Edition Prentice hall 1984.
- (2) Brain W Kernigham & Dennis M Ritchie the C Programmed Language 2nd Edition (ANSI features), Prentice Hall 1989.

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# **COURSE STRUCTURE FOR**

***M.Sc./M.A. Mathematics***  
***III & IV Semester***  
**2012-2013**

**COURSE STRUCTURE**  
**M.Sc./M.A. SEMESTER - III 2012-2013**  
**MATHEMATICS**

Name of the Papers	Theory (M.M.)	Mini. Pass. M.	C.C.E.	Mini. Pass. M.	Practical M.M.	Mini. Pass. M.	Total
Compulsory Paper I. Inregration Theory & Functional Analysis-I	40	13	10	04	---	---	50
Optional Paper's Four papers out of the following have to be chosen, opting not more than one from each group.							
Group I (1) <b>Advanced Functional Analysis-I</b> (2) <b>Partial Differential Equations</b> (3) Differentiable Structures on manifolds-I (4) <b>General Theory of Relativity and Cosmology-I</b>	40	13	10	04	---	---	50
Group II (1) Algebraic Topology-I (2) <b>Abstract Harmonic Analysis-I</b> (3) <b>Advanced Graph Theory-I</b> (4) <b>Advanced Special Function-I</b>	40	13	10	04	---	---	50
Group III (1) <b>Theory of Linear Operators-I</b> (2) <b>Advanced Numerical Analysis -I</b> (3) <b>Fuzzy Sets and their Applications-I</b>	40	13	10	04	---	---	50
Group IV (1) <b>Operations Research -I</b> (2) <b>Computational Biology -I</b> (3) <b>Jacobi Polynomial &amp; H-Function-I</b> (4) <b>Fluid Mechanics -I</b>	40	13	10	04	---	---	50
Group V (1) <b>Wavelets-I</b> (2) <b>Bio-Mechanics -I</b> (3) <b>Analytic Number Theory-I</b> (4) <b>Integral Transform-I</b>	40	13	10	04	---	---	50
Group VI (1) <b>Fundamentals of Computer Science(Theory &amp; Practical) - I</b> (2) <b>Mathematics of Finance &amp; Insurance -I</b> (3) <b>Spherical Trigonometry and astronomy-I</b>	25 40	09 13	10 10	04 04	15 ---	06 ---	50
Paper VI Comprehensive Viva- Voce							50
<b>Grand Total</b>							<b>300</b>

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कक्षा Class : **M.Sc. (Mathematics)**  
सेमेस्टर Semester : **III**  
विषय समूह का शीर्षक Title of Subject : **Advanced Functional Analysis-I**  
Group : **I(1)**  
प्रश्न पत्र कं. Paper No. : **1**  
अनिवार्य/ वैकल्पिक Compulsory/ Optional : **Optional**

**Unit-1**

Definition and examples of topological vector Spaces Convex, Balanced and absorbing sets and their properties.

**Unit-2**

Minkowski's functionals, Subspace product space and quotient space of a topological Vector space. Chapter 1 of R. Larsen.

**Unit-3**

Locally convex topological Vector Spaces. Normable and metrizable topological vector spaces .

**Unit-4**

Complete topological vector spaces and Frechet space. Chapter 2 and 3 of R. Larsen.

**Unit-5**

Linear transformations and linear functionals and their continuity. Chapter 2 and 3 of R. Larsen.

**Text Books:-**

- 1- **Functional Analysis with Applications** by A.H. Siddiqi, Tala Mc. Graw Hill Publishing Company.
- 2- **Linear Topological Spaces** by Kelley J.L. , Van Nostrand East West Press, New Delhi.

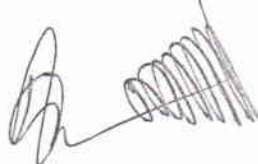
**Reference Books:-**

- 1- **Toposigical Vector spaces and Distributions** by John Horvath, Addison-Wesley Publishing Company, 1966.
- 2- **Modern methods in Topological vecotr spaces** by albert Wilansky, Mcgraw-Hill, 1978.
- 3- **Functional Analysis** by K. Chandra Sekhar Rao, Narosa 2002.

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कक्षा Class : **M.Sc. (Mathematics)**  
सेमेस्टर Semester : **III**  
विषय समूह का शीर्षक Title of Subject : **Partial Differential Equations**  
Group : **I (2)**  
प्रश्न पत्र कं. Paper No. : **2**  
अनिवार्य/ वैकल्पिक Compulsory/ Optional : **Optional**

Unit-1

Transport Equation-Initial value Problem Non-homogeneous Equation. Laplace's Equations - Fundamental Solution, Mean Value Formula, Properties of Harmonic functions, Green's Functions, Energy Methods.

Unit-2

Heat Equation - Fundamental Solution, Mean Value Formula, Properties of Solutions, Energy Methods. Wave Equation- Solution by Spherical Means, Non-homogeneous Equations, Energy Methods.

Unit-3

Nonlinear First Order PDE. Complete integrals, Envelopes, Characteristics, Hamilton-Jacobi Equations (Calculus of Variations, Hamilton's ODE, Legendre Transform, Hopf-Lax formulae)

Unit-4

Conservation Laws (Shocks, Entropy Condition Lax-Oleinic formula, Riemann's Problem, Long Time behaviour).  
Representation of Solutions- Separation of Variables, Similarity Solutions (Plane and Travelling Waves, Solutions, Similarity under Scaling)

Unit-5

Fourier and Laplace Transform, Hopf- Cole Transform, Hodographand, Legendre Transforms, Potential Functions, Power Series (non - characteristic surface, Real Analytic Functions, Cauchy - Kovalevskaya Theorem).

Recommended Books :- (1) L.C. Evans, Partial Differential Equations, 1998.

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कक्षा Class : M.Sc. (Mathematics)  
सेमेस्टर Semester : III  
विषय समूह का शीर्षक Title of Subject : Differentiable Structures on manifolds-I  
Group : I (3)  
प्रश्न पत्र कं. Paper No. : 3  
अनिवार्य/ वैकल्पिक Compulsory/ Optional : Optional

Unit-1

Submanifolds & Hyper surfaces. Normals. Gauss's formulæ, Weingarten equations.

Unit-2

Lines of Curvature. Generalized Gauss and Mainrdis - Codazzi equations.

Unit-3

almost complex manifolds, Njehuis tensors. Contravariant and covariant almost analytic vector fields.

Unit-4

F-connection, almost Hermit manifolds.

Unit-5

almost analytic vector fields. cUrvature tensor, Linera connection.

Recommended Books.

1. B.B. Sinha, An Introduction to modern Differential Geometry, Kalyani Publishers, new Delhi, 1982
2. K. Yano and M. Kon structure of Manifolds. world scientific Publishing C. Pvt. Ltd. 1984
3. A. Behaneu, Geomtry of CR- sub manifolds, D. Reidel Publishing company, Dordrecht, 1986

Reference Books:

- (i) R.S. Mishra, A course in tensor with application to Riemannian geometry

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कक्षा Class : **M.Sc. (Mathematics)**  
सेमेस्टर Semester : **III**  
विषय समूह का शीर्षक Title of Subject : **General Theory of Relativity and Cosmology-I**  
Group : **I (4)**  
प्रश्न पत्र कं. Paper No. : **4**  
अनिवार्य/ वैकल्पिक Compulsory/ Optional : **Optional**

- Unit-1 Transformation of coordinates. Tensors. Algebra of Tensors. Symmetric and skew symmetric Tensors.  
Unit-2 Contraction of tensors and quotient law. Riemannian metric. Christoffel Symbols  
Unit-3 Covariant derivatives. Gradient, Divergence and Curl.  
Unit-4 Intrinsic derivatives and geodesics, Riemann Christoffel curvature tensor and its symmetry properties.  
Unit-5 Intrinsic derivatives and geodesics, Riemann Christoffel curvature tensor and its symmetry properties.

Recommended Books:

- [1] S.R.Roy and Raj Bali: Theory of Relativity Jaipur Publishing House, Jaipur, 1987.  
[2] S. K. Shrivastva: General Relativity and Cosmology, PHI, New Delhi.  
[3] J.V. Narlikar, General Relativity and Cosmology: The Macmillan Company of India Limited, 1978.

References:

- [1] C.E. Weatherburn, An Introduction to Riemannian Geometry and the tensor Calculus, Cambridge University, Press 1950.  
[2] H. Stephani, General Relativity: An Introduction to the theory of the gravitational field, Cambridge University Press 1982.  
[3] A.S. Eddington, The Mathematical Theory of Relativity. Cambridge University Press, 1965.  
[4] R. Adler, M. Bazin, M. Schiffer, Introduction to general relativity, McGraw Hill Inc., 1975.

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कक्षा Class : M.Sc. (Mathematics)  
सेमेस्टर Semester : III  
विषय समूह का शीर्षक Title of Subject : Algebraic Topology-I  
Group : II (1)  
प्रश्न पत्र कं. Paper No. : 1  
अनिवार्य/ वैकल्पिक Compulsory/ Optional : Optional

Unit-1

Deformation retracts and homotopy type

Unit-2

Fundamental group of  $S_n$  for  $n > 1$ , and some surfaces.

Unit-3

The Jordan separation theorem,

Unit-4

The Jordan curve theorem,

Unit-5

Imbedding graphs in plane.

Book recommended :

- [1] J.R. Munkres, Topology, Second edition, Prentice - Hall of India, 2000.  
[2] J.R. Munkres, Elements of Algebraic topology, Addison - Wesley Publishing company, 1984.

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कक्षा Class : **M.Sc. (Mathematics)**  
सेमेस्टर Semester : **III**  
विषय समूह का शीर्षक Title of Subject : **Abstract Harmonic Analysis I**  
Group : **II(2)**  
प्रश्न पत्र कं. Paper No. : **2**  
अनिवार्य/ वैकल्पिक Compulsory/ Optional : **Optional**

Unit-1

Topological groups, Examples of topological groups and its basic Properties. Subgroups and quotient groups.

Unit-2

Product groups and projective limits. (See G. Bachman[1]) Continuity, homeomorphism. left translate, right translate, inversion mapping, inner automorphism,

Unit-3

Homogenous topological group . Properties of topological groups involving connectedness. Invariant pseudo-metrics and separation axioms.

Unit-4

Symmetric neighbourhood of identity, compact sets, Structure theory for compact and locally compact Abelian groups. (See Hewitt and Ross [3]), Locally compact topological groups

Unit-5

Compact support subgroups and quotient groups of topological groups, topology for quotient group, open sets, Open mapping, Hausdorff quotient group compact quotient group.

Recommended Books.

- 1- George Bachman Elements of Abstract Harmonic Analysis Academic Press, New York. 1964
- 2- Taqdir Hussain Introduction to Topological Group W.D. Saunders Company 1966 to ok W.O.
- 3- Walter Rudin, Fourier Analysis On Group Interscience publisher , John Wiley, New York, 1967

Reference Books.

- 1- Edwin Hewitt and Kenneth A. Ross. Abstract Harmonic Analysis -1, Springer - Verlag, Berlin, 1963.
- 2- Lynn H. Loomis : An Introduction to Abstract Harmonic Analysis, D, Van Nostrand Co. Princeton

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कक्षा Class : **M.Sc. (Mathematics)**  
 सेमेस्टर Semester : **III**  
 विषय समूह का शीर्षक Title of Subject : **Inregration Theory & Functional Analysis-I**  
 Group :  
 प्रश्न पत्र कं. Paper No. : **1**  
 अनिवार्य/ वैकल्पिक Compulsory/ Optional : **Compulsory**

**Unit-1**

Signed measure. Hahn decomposition theorem, mutually singular measures. Radon-Nikodim theorem. Lebesgue decomposition. Riesz representation theorem.

**Unit-2**

Extension theorem (Caratheodory), Lebesgue -Stieltjes integral, product measures, Fubini's theorem. Differentiation and Integration.

**Unit-3**

Normed linear spaces. Banach spaces and examples. Quotient space of normed linear spaces and its completeness,

**Unit-4**

Equivalent norms. Riesz lemma, basic properties of finite dimensional linear spaces and compactness.

**Unit-5**

Weak convergence and bounded linear transformations, normed linear spaces of bounded linear transformations, dual spaces with examples.

**Text Books :**

- [1] E. Kreyszig, Introductory Functional Analysis with applications, John Wiley & Sons New York.  
 [2] G.F. Simmons, Introduction to Topology & Modern Analysis Mc Graw Hill, New York.

**Reference :**

- [1] B. Choudhary and Sudarshan Nanda. Functional Analysis with applications, Wiley Eastern Ltd.

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कक्षा Class : M.Sc. (Mathematics)  
सेमेस्टर Semester : III  
विषय समूह का शीर्षक Title of Subject : **Advanced Graph Theory- I**  
Group : II(3)  
प्रश्न पत्र कं. Paper No. : 3  
अनिवार्य/ वैकल्पिक Compulsory/ Optional : **Optional**

- Unit-1 Revision of graph theoretic preliminaries, Operations on graphs. Graph Isomorphism  
Disconnected graph and their Components. Traveling salesman problem, round table  
problem,
- Unit-2 Eulerian and Hamiltonian Paths and circuits.
- Unit-3 Properties of trees, Distance centre, radius, diameter eccentricity and related theorems, Graph  
as Metric space Rooted and binary trees,
- Unit-4 Labelled graph and trees spanning tree, weighted spanning tree, Shortest path,
- Unit-5 fundamental cutsets. Rank and nullity, cutsets and cut vertices, fundamental cutsets,

Text Book :-

- 1- Graph Theory with Application to Engineering and Computer Science by Narsingh Deo.

Reference Book :-

- 1- Graph Theory by Harary.

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कक्षा Class : M.Sc. (Mathematics)  
 सेमेस्टर Semester : III  
 विषय समूह का शीर्षक Title of Subject : **Advanced Special Function I**  
 Group : II(4)  
 प्रश्न पत्र कं. Paper No. : 4  
 अनिवार्य/ वैकल्पिक Compulsory/ Optional : **Optional**

## Unit-1

Gamma and Beta Functions : The Euler or Mascheroni Constant  $\gamma$ , Gamma Function, A series for  $\Gamma'(z) / \Gamma(z)$ , Difference equation  $\Gamma'(z+1) = z\Gamma'(z)$ ,

## Unit-2

Beta function, value of  $\Gamma'(z)\Gamma'(1-z)$ , Factorial Function, Legendre's duplication formula, Gauss multiplication theorem.

Unit-3 Hypergeometric and Generalized Hypergeometric functions: Function  ${}_2F_1(a,b;c;z)$  A simple integral form evaluation of  ${}_2F_1(a,b;c;z)$

Unit-4 Contiguous function relations, Hyper geometrical differential equation and its solutions,  $F(a,b;c;z)$  as function of its parameters.

Unit-5 Elementary series manipulations, Simple transformation, Relations between functions of  $z$  and  $i$   
 $-z$

## :Books Recommended ;

- 1- Rainville, E.D. ; Special Functions, The Macmillan co., New york 1971,
- 2- Srivastava, H.M. Gupta, K.C. and Goyal, S.P. ; The H-functions of One and Two Variables with applications, South Asian Publication, New Delhi.
- 3- Saran, N., Sharma S.D. and Trivedi, - Special Functions with application, Pragati prakashan, 1986.

## Reference Books.

- 1- Lebedev, N.N, Special Functions and Their Applications, Prentice Hall, Englewood Cliffs, New jersey, USA 1995.
- 2- Whittaker, E.T. and Watson, G.N., A Course of Modern Anal

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कक्षा Class : M.Sc. (Mathematics)  
 सेमेस्टर Semester : III  
 विषय समूह का शीर्षक Title of Subject : Theory of Linear Operators I  
 Group : III(1)  
 प्रश्न पत्र कं. Paper No. : 1  
 अनिवार्य/ वैकल्पिक Compulsory/ Optional : Optional

## Unit-1

Spectral theory in normed linear spaces, resolvent set and spectrum, Spectral properties of bounded linear operators. Properties of resolvent and spectrum, Spectral mapping theorem for polynomials.

## Unit-2

Spectral radius of a bounded linear operator on a complex Banach space. Elementary theory of Banach algebras. General properties of compact linear operators. Spectral properties of compact linear operators on normed spaces. Chapter 7,8 (E. Kreyszig).

## Unit-3

Behaviours of Compact linear operators with respect to solvability of operators equations. Fredholm type theorems. Fredholm alternative theorem. Fredholm alternative for integral equations

## Unit-4

Spectral properties of bounded self-adjoint linear operators on a complex Hilbert space. Positive operators. Monotone sequence theorem for bounded self-adjoint operators on a complex Hilbert space.

## Unit-5

Square roots of a positive operator. projection operators. Spectral family of a bounded self-adjoint linear operator and its properties.

## Recommended Books:

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

## Reference Books:

- (1) P. R. Halmos Introduction to Hilbert space and the theory of Spectral Multiplicity, Second edition, Chelsea publishing co. N.Y. 1957.  
 (2) N. Dunford and J.T. Schwartz, linear operator -3 part, Interscience / Wiley, New York 1958-71.  
 (3) G. Bachman and L. Narci, Functional analysis, Academic press New York, 1966.

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कक्षा Class : **M.Sc. (Mathematics)**  
सेमेस्टर Semester : **III**  
विषय समूह का शीर्षक Title of Subject : **Advanced Numerical Analysis I**  
Group : **III(2)**  
प्रश्न पत्र कं. Paper No. : **3**  
अनिवार्य/ वैकल्पिक Compulsory/ Optional : **Optional**

Unit-1

Piece wise and spline interpolation

Unit-2

Bivariate interpolation Approximation,

Unit-3

Least squares approximation

Unit-4

Uniform approximation Rational approximation, choice of method

Unit-5

Numerical differentiation optimum choice of step length

Text book -

- (1) Numerical Methods for scientific and Engineering computation by M.K. Jain, S.R.K. Iyenger,  
R.K. Jain south Edition (2003) New Age.

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कक्षा Class : M.Sc. (Mathematics)  
 सेमेस्टर Semester : III  
 विषय समूह का शीर्षक Title of Subject : Fuzzy Sets and Their Applications I  
 Group : III(3)  
 प्रश्न पत्र कं. Paper No. : 4  
 अनिवार्य/ वैकल्पिक Compulsory/ Optional : Optional

## Unit-1

Fuzzy Sets-Basic definitions,  $\alpha$ -level sets, convex fuzzy sets.

## Unit-2

Basic operations on fuzzy sets Types of fuzzy sets, Cartesian, Product, Algebraic products.

## Unit-3

Bounded sum and difference, t-norms and T - co norms.

## Unit-4

The Extension Principle - The Zadeh's extension principle.

## Unit-5

Image and inverse image of fuzzy sets, fuzzy numbers, Elements of fuzzy arithmetic.

## Text Books:

- (1) Fuzzy set theory and its Applications by H.J. Zimmermann, Allied Publishers Ltd., New Delhi, 1991.
- (2) Fuzzy sets and Fuzzy logic by G.J. Klir and B. Yuan Prentice - Hall of India, New Delhi, 1995

## Reference Books:-

- (1) Fuzzy sets and Uncertainty and Information by G.J. Kalia Tina A. Folger - Prentice - Hall of India.

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कक्षा Class : **M.Sc. (Mathematics)**  
सेमेस्टर Semester : **III**  
विषय समूह का शीर्षक Title of Subject : **Operations Research I**  
Group : **IV(1)**  
प्रश्न पत्र कं. Paper No. : **1**  
अनिवार्य/ वैकल्पिक Compulsory/ Optional : **Optional**

Unit-i

Operations Research and its scope, Origin and Development of Operations Research, Necessity of Operations Research in Industry, Characteristics of Operations Research. Model in Operations Research, Phase of Operations Research, Uses and Limitations of Operation Research,

Unit-2

Linear Programming Problems, Graphical Solution Method, General Linear Programming Problems, Mathematical Formulation, Graphical Solution Method.

Unit-3

Simplex Method exceptional cases, artificial variable techniques ; Big M method, two phase Method , Problem of degeneracy.

Unit-4 Duality: Fundamental Properties of duality and theorem of duality.

Unit-5

Transportation problems, Assignments problems.

Recommended Books :-

1- Kanti Swarup, P.K. Gupta and Manmohan, Operations Research, Sultan Chand & Sons, New Delhi.

Reference Books:-

- 1- S.D, Sharma, Operation Research,
- 2- F.S, Hiller and G.J. Lieberman, Industrial Engineering Series, 1995 (This book comes with a CD containing software)
- 3- G. Hadley , Linear Programming, Narosa Publishing House. 1995.
- 4- G. Hadley, Linear and Dynamic programming, Addison - Wesley Reading Mass.
- 5- H.A. Taha, Operations Research - An introduction, Macmillan Publishing co. Inc. New york.
- 6- Prem Kumar Gupta and D.S. Hira, Operation Research, an Introduction, S. Chand & Company Ltd. New Delhi.
- 7- N.S. Kambo, Mathematical Programming Techniques, Affiliated East - West Pvt. Lt

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कक्षा Class : **M.Sc. (Mathematics)**  
सेमेस्टर Semester : **III**  
विषय समूह का शीर्षक Title of Subject : **Computational Biology- I**  
Group : **IV(2)**  
प्रश्न पत्र कं. Paper No. : **2**  
अनिवार्य/ वैकल्पिक Compulsory/ Optional : **Optional**

Unit-1 Basic concepts of Molecular biology  
Unit-2 DNA and Proteins, The Central Dogma, Gene and Genome Sequences.  
Unit-3 Restriction Maps - Graphs, Interval graphs. Measuring Fragment sizes.  
Unit-4 Algorithms for double digest problem (DDP) - Algorithms and complexity.  
Unit-5 Approaches to DDP.

**Text Books:-**

- 1- Introduction to Computational Biology by M.S, Waterman Chapman & Hall. 1995
- 2- Bio informatics - A practical Guide to the analysis of Genes and Proteins by A. Baxevanis and B. Ouelette, WileyInterscience (1998).

**Reference Books:-**

- 1- Introduction to Bio informatics by Attwood.
- 2- Bioinformatics-Sequence and Genome analysis by David W.Mount.

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कक्षा Class : **M.Sc. (Mathematics)**  
सेमेस्टर Semester : **III**  
विषय समूह का शीर्षक Title of Subject : **Jacobi Polynomial and H-Function I**  
Group : **IV(3)**  
प्रश्न पत्र कं. Paper No. : **3**  
अनिवार्य/ वैकल्पिक Compulsory/ Optional : **Optional**

Unit-1

Jacobi Polynomials. Bateman's Generating functions.

Unit-2

Rodrigues formula Orthogonality.

Unit-3

Differential recurrence relations. Pure recurrence relations. Mixed relations.

Unit-4

The H Functions of one variable. Definition. Asymptotic expansion.

Unit-5

Simple transformation and elementary properties. Mellin and Laplace transforms. Special cases.

Books Recommended :

- 1- Rainville. E.D. : Special Functions. The Macmillan Co.. New. York. 1971.
- 2- Shrivastava. H.M. , Gupta K.C. and Goyal. S.P. : The H- Functions of One and Two Variables with applications. South Asian Publication New Delhi.

Reference Books :

- 1- Lebedev. N.N. Special functions and Their Applications. Prentice Hall. Englewood Hall phase new jersey USA, 1965.
- 2- Whittaker. E.T, and Watson G.N. A Course of Modern analysis. Cambridge University Press. London 1963

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कक्षा Class : M.Sc. (Mathematics)  
सेमेस्टर Semester : III  
विषय समूह का शीर्षक Title of Subject : Fluid Mechanics- I  
Group : IV(4)  
प्रश्न पत्र का क्र. Paper No. : 4  
अनिवार्य/ वैकल्पिक Compulsory/ Optional : Optional

- Unit-1 Lagrangian and Eulerian Methods  
Unit-2 equation of continuity, types of flow lines, velocity potential.  
Unit-3 stream function irrotational and rotational motions, vortex lines.  
Unit-4 Lagrange's and Euler's equation of motion, Bernoulli's theorem.  
Unit-5 irrotational motion in two dimensions.

Text Books :-

- 1- A text book of Fluid Mechanics in SI units by R.K. Rajput.
- 2- An introduction to Fluid Dynamics by R.K. Rathy, Oxford and IBH Published Co.

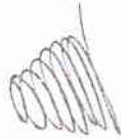
Reference Books:

- 1- Fluid Mechanics (Springer) By Joseph H. Spurk.
- 2- Fluid Mechanics by Irfan A Khan (H.R. W.)
- 3- An Introduction to Fluid Mechanics by G.K. Batchelor, Foundation Books, New Delhi, 1994.

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अधिकतम अंक/Max. Marks 50

कक्षा Class : **M.Sc. (Mathematics)**  
सेमेस्टर Semester : **III**  
विषय समूह का शीर्षक Title of Subject : **Wavelets- I**  
Group : **V(1)**  
प्रश्न पत्र कं. Paper No. : **1**  
अनिवार्य/ वैकल्पिक Compulsory/ Optional : **Optional**

Unit-1 Haar's simple wavelets

Unit-2 Haar Wavelet transforms, Inverse Haar Wavelet transforms,

Unit-3 Multi dimensional wavelets, Two - dimensional Haar Wavelets.

Unit-4 Application of wavelets, Noise reduction Data compression, Edge detection, Daubechies wavelet (DW),

Unit-5 approximation of samples with D wavelets, Fast DW transform and its inverse.

Text Books:-

- 1- Wavelets made easy by Y. Nievergelt
- 2- A first Course on Wavelets by E. Hernandez and G. Weiss.

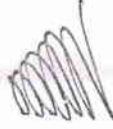
Reference Books.

- 1- An Introduction to Wavelets by Chui, Academic Press.

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कक्षा Class : M.Sc. (Mathematics)  
सेमेस्टर Semester : III  
विषय समूह का शीर्षक Title of Subject : Bio-Mechanics- I  
Group : V(2)  
प्रश्न पत्र कं. Paper No. : 2  
अनिवार्य/ वैकल्पिक Compulsory/ Optional : Optional

- Unit-1 Bio-physics of Human Cardio - vascular system: Types of Blood Vessels, Properties of Blood  
Unit-2 Flow in Tubes, Poiseuibles law, Erythrocyte Sedimentation Rate . Stroke's law , Palatial flow in elastic vessels.  
Unit-3 Bio - physics of Human Thermo- Regulation Head Flow in Human Dermal and Subdermal parts  
Unit-4 Derivation of Governing partial differential equations Incorporating  
Unit-5 Microcirculation and perspiration.

Text books:

- 1- Introduction to Mathematical Biology by S.I. Rubinow, J. Wiley & Sons.
- 2- Biomechanics by Y.C, Fung, Springer - Verlag.
- 3- Introduction to Biomathematics by V.P. Saxena, Vishwa Prakashan (Wiley eastern)

Reference Book :-

- 1- Biofluid Dynamics by Mazumdar.

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कक्षा Class : M.Sc. (Mathematics)  
सेमेस्टर Semester : III  
विषय समूह का शीर्षक Title of Subject : Analytic Number Theory- I  
Group : V(3)  
प्रश्न पत्र कं. Paper No. : 3  
अनिवार्य/ वैकल्पिक Compulsory/ Optional : Optional

- Unit-1 Characters of finite abelian groups  
Unit-2 The Character Group, Dirichlet characters  
Unit-3 Sums involving Dirichlet characters.  
Unit-4 Dirichlet Theorem on primes in arithmetic progressions.  
Unit-5 Dirichlet series and Euler products,

Book Recommended :

- 1- T.M. Apostol, Introduction to Analytic Number Theory, Narosa Pub, House, 1989.

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कक्षा Class : M.Sc. (Mathematics)  
सेमेस्टर Semester : III  
विषय समूह का शीर्षक Title of Subject : Integral Transform I  
Group : V(4)  
प्रश्न पत्र कं. Paper No. : 4  
अनिवार्य/ वैकल्पिक Compulsory/ Optional : Optional

Unit-1

Application of Laplace Transforms

Unit-2

Laplace's equations.

Unit-3

Laplace's wave equation

Unit-4

Application of Laplace Transforms

Unit-5

Heat conduction equation.

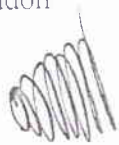
Books recommended :-

- [1] Integral Transforms by Goyal & Gupta.
- [2] Integral Transforms by Sneddon

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कक्षा : Class : **M.Sc. (Mathematics)**  
सेमेस्टर Semester : **III**  
विषय समूह का शीर्षक Title of Subject : **Fundamentals of Computer Science - I**  
**(Theory and Practical)**  
Group : **VI(1)**  
प्रश्न पत्र कं. Paper No. : **1**  
अनिवार्य/ वैकल्पिक Compulsory/ Optional : **Optional**

**Unit 1 -**

Object Oriented Programming Paradigm, Basic Concepts, Benefits and Applications of Object Oriented Programming.

**Unit 2 -**

C++ - Introduction, Tokens, Keywords, Identifiers and Constants, Basic Data Types, User-Defined Data Types, Derived Data Types, Variables, Operators in C++, Expressions, Implicit Conversions.

**Unit 3 -**

Operator Overloading, Operator Precedence, Control Structure - The if Statement, The switch Statement, The do...while Statement, The while Statement, The for statement.

**Unit 4 -**

Functions in C++, The main Function, Function Prototyping, Call by Reference, Inline Function, Function Overloading, Friend and Virtual Functions.

**Unit 5 -**

Classes and Objects : Specifying a Class, Defining Member Function, Nesting of Member Function, Private Member Functions, Arrays within a Class, Static Data Members, Static Member Functions, Pointers to Members.

**Reference Books :**

- [1] E. Balagurusamy, Object Oriented Programming with C++, III Edition, Tata McGraw-Hill Publishing Company Limited, New Delhi.
- [2] B. Stroustrup, The C++ programming Language, Addison Wesley.

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कक्षा Class : M.Sc. (Mathematics)  
सेमेस्टर Semester : III  
विषय समूह का शीर्षक Title of Subject : Mathematics of Finance and Insurance- I  
Group : VI(2)  
प्रश्न पत्र का. Paper No. : 2  
अनिवार्य/ वैकल्पिक Compulsory/Optional : Optional

Unit-1 Elements of Theory of Interest

Unit-2 Flow Valuation Annuities

Unit-3 Amortization and Sinking Funds, brief review of probability theory.

Unit-4 Survival Distributions, Life Tables, Valuing Contingent Payment Life insurance,

Unit-5 life annuities, Net Premiums Insurance Models including Expenses.

Text Books:

- 1 Options, Futures and other Derivatives by Jhon C. Hull Prentice-Hall of India Pvt. Ltd.
- 2 An introduction to Mathematic Finance by Cheldon M. Ross. Cambridge University Press

Reference Books:

- 1 An Introduction to Mathematics of Financial Derivatives by Salih N.Neftci, Academic Press. Inc.
- 2 Mathematics of Financial markets by Ribert J. Elliot & P.E. Kopp Springer Verlag, New York  
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कक्षा Class :

M.Sc. (Mathematics)

सेमेस्टर Semester :

III

विषय समूह का शीर्षक Title of Subject :

Spherical Trigonometry an Astronomy- I

Group :

VI(3)

प्रश्न पत्र कं. Paper No. :

4

अनिवार्य/ वैकल्पिक Compulsory/ Optional : **Optional**

Unit-1 Fundamental of Spherical Trigonometry

Unit-2 solution of right angled triangle

Unit-3 Properties of Right angle triangle

Unit-4 Relation between Sides & angles of a Spherical triangle :

Unit-5 Application of Spherical triangle & Examples.

Text Books:-

1- A text book of spherical trigonometry : Gorakh Prasad.

2- A text book of spherical Astronomy : Gorakh Prasad.

Reference Book.

1- Spherical Astronomy - Smarat

2- spherical Astronomy - Bell

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## MATHEMATICS

Name of the Papers	Theory (M.M.)	Mini. Pass. M.	C.C.E.	Mini. Pass. M.	Practical M.M.	Mini. Pass. M.	Total
Compulsory Paper I. <b>Functional Analysis-II</b>	40	13	10	04	---	---	50
Optional Paper's Four papers out of the following have to be chosen, opting not more than one from each group.							
Group I (1) <b>Advanced Functional Analysis-II</b> (2) <b>Mechanics</b> (3) Differentiable Structures on manifolds-II (4) General Theory of Relativity and Cosmology-II	40	13	10	04	---	---	50
Group II (1) Algebraic Topology-II (2) <b>Abstract Harmonic Analysis-II</b> (3) Advanced Graph Theory-II (4) <b>Advanced Special Function-II</b>	40	13	10	04	---	---	50
Group III (1) <b>Theory of Linear Operators-II</b> (2) Advanced Numerical Analysis -II (3) Fuzzy Sets and their Applications-II	40	13	10	04	---	---	50
Group IV (1) <b>Operations Research -II</b> (2) Computational Biology -II (3) Jacobi Polynomial & H-Function-II (4) Fluid Mechanics -II	40	13	10	04	---	---	50
Group V (1) Wavelets-II (2) Bio- Mechanics -II (3) Analytic Number Theory-II (4) <b>Integral Transform-II</b>	40	13	10	04	---	---	50
Group VI (1) <b>Fundamentals of Computer Science (Theory &amp; Practical) -II</b> (2) Mathematics of Finance & Insurance -II (3) Spherical Trigonometry and astronomy-II	25 40	09 13	10 10	04 04	15 ---	06 ---	50
Paper VI Comprehensive Viva-Voce							50
Paper VII Job Oriented Project Work							50
<b>Grand Total</b>							<b>350</b>

**Note:** Above Mentioned bold Optional Papers are teaching in the University and Colleges. If any College wants to change their optional Papers. Kindly inform to the Dy. Registrar (Examination), Vikram University, Ujjain.


  
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अधिकतम अंक/Max. Marks 50

कक्षा Class : M.Sc. (Mathematics)

Theory Marks : 40

सेमेस्टर Semester : IV

C.C.E. Marks : 10

विषय समूह का शीर्षक Title of Subject : Functional Analysis II

Group :

प्रश्न पत्र कं. Paper No. : 1

अनिवार्य/ वैकल्पिक Compulsory/ Optional : Compulsory

Unit-1

Uniform boundedness theorem and some of its consequences. Open mapping and closed graph theorems. Hahn-Banach theorem for real linear spaces.

Unit-2

Complex linear spaces and normed linear spaces. Reflexive spaces. Weak Sequential compactness, Compact operators, Solvability of linear equations in Banach spaces.

Unit-3

The Closed range theorem, Inner product spaces, Hilbert spaces, orthonormal sets, Bessels inequality.

Unit-4

Complete Orthonormal sets and Parseval's identity, Structure of Hilbert spaces. projection theorem. Riesz representation theorem.

Unit-5

Adjoint of an operator on a Hilbert space. Reflexivity of Hilbert spaces. Self-adjoint operators, Positive operators, Projection, and Unitary operators.

Text Books :

[1] E. Kreyszig, Introductory Functional Analysis with applications, John Wiley & Sons.

[2] G.F. Simmons, Introduction to Topology & Modern Analysis Mc Graw Hill, New

Reference :

[1] B. Choudhary and Sudarshan Nanda. Functional Analysis with applications, Wiley Eastem Ltd. .

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कक्षा Class : M.Sc. (Mathematics) Theory Marks : 40  
सेमेस्टर Semester : IV C.C.E. Marks : 10  
विषय समूह का शीर्षक Title of Subject : Advanced Functional Analysis-II  
Group : I(1)  
प्रश्न पत्र कं. Paper No. : 1  
अनिवार्य/ वैकल्पिक Compulsory/ Optional : Optional

Unit-1

Finite - dimensional topological vector spaces. Linear Varieties and Hyperplanes. Geometric form of Hahn -Banch theorem. . Chapter 2(2.2), 5(5.1, 5.2) 6(6.2), 7 and 9 (9.4) of R. Larsen.

Unit-2

Uniform - Boundedness principle. Open Mapping theorem and closed graph theorem for Frehet spaces, Banach - Alaouglu theorem. Chapter 6(6.2), 7 and 9 (9.4) of R. Larsen.

Unit-3

Extreme points and Extremal sets. Krein- Milman's theorem. Duality polar. Bipolar theorem. Baralled and Bornological spaces.

Unit-4

Macekey Spaces. Sami-reflexive and Reflexive topological vector spaces. Montel Spaces and Schwarz spaces. Quasi-completeness. Chapter 11(11.1, 11.2) of R. Larsen

Unit-5

Inverse Limit and inductive limit of locally convex spaces. Distributions. [Walter Rudin and L.V. Kantorovich and G.P. Akilov].

**Recommended Books :**

- [1] R.Larsen, Functional Analysis, Marcel Dekker, Inc. New york, 1973.
- [2] Walter Rudin, Functional Analysis, TMH Edition, 1974.
- [3] L.V.Kantorovich and G.P. Akilov, Functional Analysis, Pergamon Press 1982.

**Reference Books :**

1. Laurent Schwartz, Functional Analysis Courant Institute of Mathematical Sciences, New York University, 1964.

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		अधिकतम अंक/Max. Marks 50
कक्षा Class :	<b>M.Sc. (Mathematics)</b>	<b>Theory Marks : 40</b>
सेमेस्टर Semester :	<b>IV</b>	<b>C.C.E. Marks : 10</b>
विषय समूह का शीर्षक Title of Subject :	Mechanics	
Group :	I(2)	
प्रश्न पत्र कं. Paper No. :	2	
अनिवार्य/ वैकल्पिक Compulsory/ Optional :	<b>Optional</b>	

#### Unit-1

Generalized coordinates. Holonomic and Non-holonomic systems. Scleronomic and Rheonomic System Generalized Potential. Lagrange's equations of first kind. Lagrange's equations of second Kind. Uniqueness of solution. Energy equation for conservative fields.

#### Unit-2

Hamilton's variables, Hamilton's canonical equations, Donkin's theorem, Matovating probelms of calculus of variations, Shortest distance. Minimum surface of revolution. Brachistochrone problem. Fundamental lemma of calculus of variations. Euler's equation for one dependent function and its generalization to (i) n dependent functions. (ii) higher order derivatives.

#### Unit-3

Hamilton's Principle. Principle of least action, Hamilton-Jacobi equation (time-dependent and time-independent), Whittaker's equations, Statement of Lee HWA Chung's theorem, Poincare Carten Integal invariant.

#### Unit 4-

Poisson's Bracket. Poisson's Identity. Jacobi-Poisson theorem, Lagrange Brackets. Condition of canonical character of a transformation in terms of Lagrange brackets and Poisson brackets, Invariance of Lagrange brackets and Poisson brackets under canonical transformations.

#### Unit-5

Hamilton-Jacobi Theory: Solution of Hamilton-Jacobi equation, Jacobi theorem. Method of saperation of variables.

Attraction and Potential of rod, disc, Spherical shells and sphere.

#### Reference Books:

- (1) Narayanan Chandra Rana & Pramod Sharad Chandra Joag, Classical Mechanics, Tata Mcgraw Hill 1991.
- (2) F. Gantmacher, Lectures in Analytic Mechanics MIR Publishers.
- (3) M. Ray, Attraction and Potential, Student's Friends and Company, Agra.
- (4) H. Goldstein Classical Machanics (2nd Edition), Narosa Publishing House , .

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अधिकतम अंक/Max. Marks 50

कक्षा Class : M.Sc. (Mathematics) Theory Marks : 40  
सेमेस्टर Semester : IV C.C.E. Marks : 10  
विषय समूह का शीर्षक Title of Subject : Differentiable Structures on manifolds-II  
Group : I(3)  
प्रश्न पत्र कं. Paper No. : 3  
अनिवार्य/ वैकल्पिक Compulsory/ Optional : **Optional**

Unit-1

Kahler manifolds. Affine connection

Unit-2

Holomorphic sectional curvature. Curvature tensor. Almost analytic vector fields.

Unit-3

Nearly Kahler manifolds, Curvature identities. Constant Holomorphic sectional curvature

Unit-4

Almost analytic vector fields Almost Kahler Manifold Anilities vector fields, Almost Contact manifolds : Lie derivative normal contact structure

Unit-5

Affinely almost almost cosymplectic manifold, Almost Grayn manifolds: D-conformal transformation, Particular affined connection K- Contact Rumanian manifolds.

Reference Books.

- 1- B.B, Sinha, An Introduction to Modern Differential Geometry, Kalyani Publishers, New Delhi. 1982.
- 2- K. Yano and M. Kon, Structure of Manifolds, World Scientific Publishing co-Pvt. Ltd. 1984.
- 3- A. Bejaneu, Geometry of Cr- Submanifolds, D. Reidel Publishing Company, , 1986

Reference Books:

- 1- R.S, Mishra, A course in tensors with application to Riemannian geometry pothishala Pvt. Ltd. 1965.
- 2- R.S. Mishra, Structures on Differentiable manifold and their applications, Chandrema Prakashan , 1984.

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अधिकतम अंक/Max. Marks 50  
 Theory Marks : 40  
 C.C.E. Marks : 10

संकेतक Semester :  
 IV  
 General Theory of Relativity and Cosmology-II  
 Group :  
 I(4)  
 पत्र पर क्र. Paper No. :  
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 अतिरिक्त/ वैकल्पिक Compulsory/Optional : Optional

Unit-1  
 Review of the special theory of relativity and the Newtonian Theory of gravitation. Principle of equivalence and general covariance, geodesic principle.  
 Unit-2  
 Newtonian approximation of relativistic equations of motion. Einstein's field equations and its Newtonian approximation.  
 Unit-3  
 Schwarzschild external solution and its isotropic form. Planetary orbits and analogues of Kepler's Laws in general relativity. Advance of perihelion of a planet  
 Unit-4  
 Bending of light rays in a gravitational field. Gravitational redshift of spectral lines. Radar echo delay.  
 Unit-5  
 Energy-momentum tensor of a perfect fluid. Schwarzschild internal solution. Boundary conditions.

Recommended Books:  
 [1] S.R.Roy and Raj : Theory of Relativity Jaipur Publishing House, Jaipur, 1987.  
 [2] S. K. Shrivastva: General Relativity and Cosmology, PHI, .  
 [3] J.V. Narlikar, General Relativity and Cosmology: The Macmillan Company of Limited, 1978.

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अधिकतम अंक/Max. Marks 50

कक्षा Class : **M.Sc. (Mathematics)** **Theory Marks : 40**  
सेमेस्टर Semester : **IV** **C.C.E. Marks : 10**  
विषय समूह का शीर्षक Title of Subject : Algebraic Topology-II  
Group : II(1)  
प्रश्न पत्र कं. Paper No. : 1  
अनिवार्य/ वैकल्पिक Compulsory/ Optional : **Optional**

Unit-1

Free product of groups, Free groups, the Siefert - van Kampen theorem and its applications

Unit-2

Classification of Surfaces : Fundamental groups of surfacees,

Unit-3

Homology of surfaces, Cutting and pasting Construction of Compact surfaces,

Unit-4

Cutting and pasting Construction of Compact surfaces, Equivalence The classification theorem.

Unit-5

Equivalence of covering space, Covering transformations, The universal covering space and its existence. :

Book recommended :

- [1] J.R. Munkres, Topology, Second edition, Prentice - Hall of India, 2000.
- [2] J.R. Munkres, Elements of Algebraic topolgy, Addison -

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अधिकतम अंक/Max. Marks 50

कक्षा Class : M.Sc. (Mathematics) Theory Marks : 40  
सेमेस्टर Semester : IV C.C.E. Marks : 10  
विषय समूह का शीर्षक Title of Subject : Abstract Harmonic Analysis-II  
Group : II(2)  
प्रश्न पत्र कं. Paper No. : 2  
अनिवार्य/ वैकल्पिक Compulsory/ Optional : **Optional**

#### Unit-1

The Haar covering function Existence and properties of Haar covering function Definition and properties of the function  $Ig(f)$ . Existence and Uniqueness of the Haar integral,

#### Unit-2

Translation in  $Lp(G)$ , uniform continuity of translation character, Characters, Characters group, properties of characters

#### Unit-3

Character group or dual group Locally compact abelian group non - trivial complex homomorphism.

#### Unit-4

The Fourier transform, Convolution, convolution of function set  $A(\Gamma)$  of all Fourier transforms invariance, of  $A(\Gamma)$ ,

#### Unit-5

Fourier Stieltjes transform set  $B(\Gamma)$  of all Fourier Stieltjes transform, invariance of  $B(\Gamma)$ , Duality Theorem.

#### Recommended Books.

- 1- George Bachman Elements of Abstract Harmonic Analysis Academic Press, New Your. 1964
- 2- Taqdir Hussain Introduction to Topological Group W.D. Saudss Company 1966 to ok W.O.
- 3- Walter Rudin, Fourier Analysis On Group Intersceince publisher, John wiley, New York, 1967

#### Reference Books.

- 1- Edwin Hewit and Kenneth A. Ross. Abstract Harmonic Analysis -1, Springer - Verlag, Berlin, 1963.
- 2- Lynn H. Loomis : An Introduction to Abstract Harmonic Analysis, D, Van Nostrand Co. Princeton.

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अधिकतम अंक/Max. Marks 50

कक्षा Class :

M.Sc. (Mathematics)

Theory Marks : 40

सेमेस्टर Semester :

IV

C.C.E. Marks : 10

विषय समूह का शीर्षक Title of Subject :

Advanced Graph Theory-II

Group :

II(3)

प्रश्न पत्र कं. Paper No. :

3

अनिवार्य/ वैकल्पिक Compulsory/ Optional : **Optional**

Unit-1

Connectivity and separability in graphs Abstract graphs geometric graphs planar graphs  
Kurtowski two graphs embedding and regions of a planar graphs Detection of planarity

Unit-2

Geometric dual and combinationa dual.

Unit-3

Coloring and covering of graphs, Chromatic, Polynomial chromatic partitioning Dimmer  
problem Domination sets independent sets, Four colour conjecture.

Unit-4

Digraph and types of digraphs, Digraph and binary relation Equivalence relation in a graph  
Directed path walk circuit and connectedness Eulerian digraph, arborscence matrices A, B and C  
of digraphs.

Unit-5

Adjacency metric of a digraph, Alogorithms, Kruskal algorithm, Prism algorithm, Dijkstra  
Algorithm.

Text Book :-

1- Graph Theory with Application to Engineering and Computer Science by Narsingh Deo.

Reference Book :-

1- Graph Theory by Harary.

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कक्षा Class :	M.Sc. (Mathematics)	Theory Marks : 40
सेमेस्टर Semester :	IV	C.C.E. Marks : 10
विषय समूह का शीर्षक Title of Subject :	Advanced Special Function-II	
Group :	II(4)	
प्रश्न पत्र कं. Paper No. :	4	
अनिवार्य/ वैकल्पिक Compulsory/ Optional :	Optional	

## Unit-1

Bessel function and Legendre polynomials : Definition of  $J_n(z)$ , Bessel's differential equation, Generating function, Bessel's integral with index half and an odd integer,

## Unit-2

Generating function for Legendre polynomials Rodrigues formula, Bateman's generating function, Additional generating functions, Hypergeometric forms of  $P_n(X)$ , Special properties of  $P_n(X)$ , Some more generating functions, Laplace's first integral form, Orthogonality.

## Unit-3

Special properties of  $P_n(X)$ , Some more generating functions, Laplace's first integral form, Orthogonality.

## Unit-4

Definition of Hermite polynomials  $H_n(x)$ , Pure recurrence relations, Differential recurrence relations, Rodrigue's formula, Other generating functions, Orthogonality, Expansion of polynomials, more generating functions.

## Unit-5

Laguerre Polynomials : The Laguerre Polynomials  $L_n(X)$ , Generating functions, Pure recurrence relations, Differential recurrence relation, Rodrigue's formula, Orthogonal, Expansion of polynomials, Special properties, Other generating functions.

## Books Recommended ;

- 1- Rainville, E.D. ; Special Functions, The Macmillan co., New York 1971,
- 2- Srivastava, H.M. Gupta, K.C. and Goyal, S.P.; The H-functions of One and Two Variables with applications, South Asian Publication, New Delhi.
- 3- Saran, N., Sharma S.D. and Trivedi, - Special Functions with application, Pragati prakashan, 1986.

## Reference Books.

- 1- Lebedev, N.N, Special Functions and Their Applications, Prentice Hall, Englewood Cliffs, New Jersey, USA 1995.
- 2- Whittaker, E. T. and Watson, G.N., A Course of Modern Analysis Cambridge University Press, London, 1963

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अधिकतम अंक/Max. Marks 50

कक्षा Class : M.Sc. (Mathematics) Theory Marks : 40  
सेमेस्टर Semester : IV C.C.E. Marks : 10  
विषय समूह का शीर्षक Title of Subject : Theory of Linear Operators-II  
Group : III(1)  
प्रश्न पत्र कं. Paper No. : 1  
अनिवार्य/ वैकल्पिक Compulsory/ Optional : **Optional**

Unit-1

Spectral representation of bounded self-adjoint linear operators. Spectral theorem. Spectral measures. Spectral Integral.

Unit-2

Regular Spectral Measure. Real and Complex Spectral Measure. Complex Spectral Integral. Description of the Spectral Subspaces. Characterization of the Spectral Subspaces.

Unit-3

The Spectral theorem for bounded Normal Operators. Unbounded linear operators in Hilbert space. Hellinger- Toeplitz theorem. Hilbert adjoint operators.

Unit-4

Symmetric and self-adjoint linear operators. Closed linear operators and closures. Spectrum of an unbounded self-adjoint linear operators.

Unit-5

Spectral theorem for unitary and self-adjoint linear operators. Multiplication operator and Differentiation Operator. Chapter 10, E. Kreyszig.

Recommended Books:

- (1) E. Kreyszig Introductory functional analysis with applications, Jhon wiley & Sons, Nwe York, 1978.

Referance Books:

- (1) P. R. Halmos Introduction to Hilbert space and the theory of Spectral Multiplicity, Second edition, Chelsea publishing co. N.Y. 1957.
- (2) N. Dundford and J.T. Schwartz, linear operator -3 part, Interscience / Wiley, New York 1958-71.
- (3) G.Bachman and L. Narci, Functuaional analysis, Academic press , 1966

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अधिकतम अंक/Max. Marks 50

कक्षा Class : M.Sc. (Mathematics) Theory Marks : 40  
सेमेस्टर Semester : IV C.C.E. Marks : 10  
विषय समूह का शीर्षक Title of Subject : Advanced Numerical Analysis -II  
Group : III(2)  
प्रश्न पत्र कं. Paper No. : 2  
अनिवार्य/ वैकल्पिक Compulsory/ Optional : **Optional**

Unit-1

Extrapolation methods ordinary differential equations. multi step methods Predictor and corrector method

Unit-2

stability analysis of multistep methods. Ordinary differential equation

Unit-3

boundary value problems shooting method.

Unit-4

Finte difference methods

Unit-5

finite element method

Text book -

- (1) Numerical Mmethod for scientific and Engineering computation by M.K. Jain, S.R.K. Iyenger, R.K. Jain south Edition (2003) New Age.

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अधिकतम अंक/Max. Marks 50

कक्षा Class : M.Sc. (Mathematics) Theory Marks : 40  
सेमेस्टर Semester : IV C.C.E. Marks : 10  
विषय समूह का शीर्षक Title of Subject : Fuzzy Sets and their Applications-II  
Group : III(3)  
प्रश्न पत्र कं. Paper No. : 3  
अनिवार्य/ वैकल्पिक Compulsory/ Optional : **Optional**

Unit-1

Fuzzy Relation and fuzzy graphs - Fuzzy relation on Fuzzy sets, Composition of Fuzzy relation,

Unit-2

Min-Max composition and its properties, Fuzzy equivalence relation Fuzzy compatibility relation  
Fuzzy relation equation Fuzzy graphs, Similarity relation.

Unit-3

Possibility Theory-Fuzzy measures, Evidence theory, Necessity Measure, possibility measure,

Unit-4

possibility distribution, possibility theory and fuzzy sets possibility theory versus probability theory.

Unit-5

Fuzzy Logic-An overview of classical logic, multivalued logics, Fuzzy proposition Fuzzy quantifiers  
Linguistic variables and hedges, Inference from conditional fuzzy proposition, the compositional rule of  
inference.

Text Books:

- (1) Fuzzy set theory and its Applications by H.J. Zimmermann, Allied Publishers Ltd., 1991.
- (2) Fuzzy sets and Fuzzy logic by G.J. Klir and B. Yuan Prentice - Hall of India, 1995

Reference Books:-

- (1) Fuzzy sets and Uncertainty and Information by G.J. Kalia Tina A. Folger - Prentice - Hall of India.

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कक्षा Class : **M.Sc. (Mathematics)** Theory Marks : 40  
सेमेस्टर Semester : **IV** C.C.E. Marks : 10  
विषय समूह का शीर्षक Title of Subject : Operations Research -II  
Group : **IV(1)**  
प्रश्न पत्र कं. Paper No. : **1**  
अनिवार्य/ वैकल्पिक Compulsory/ Optional : **Optional**

Unit-1

Network analysis, constraints in Network, Construction of network, Critical Path Method (CPM) PERT, PERT Calculation, Resource Levelling by Network Techniques and advances of network (PERT/CPM).

Unit-2

Dynamic Programming - recursive equation approach, Characteristic of Dynamic Programming, Computational procedure, Integer programming Gomory's all I.P.P. method, Branch and Bound Technique.

Unit-3

Game theory - Two person Zero-sum games, Maximix-Minimax principle, games with out saddle points - Mixed strategies, Graphical solution of  $2 \times n$  and  $m \times 2$  Games, Solution by Linear Programming,

Unit-4

Non-linear programming: Mathematical Formulation, General Non-linear Programming Problems, Problems of Constrained Maxima and Minima (Kuhn-Tucker Condition), Non-negative Constraints,

Unit-5

Quadratic programming: Wolfe's Modified Simplex method, Beale's Method, Separable programming, Convex programming, Separable programming algorithms.

Recommended Books :-

1- Kanti Swarup, P.K. Gupta and Manmohan, Operations Research, Sultan Chand & Sons, New Delhi.

Reference Books:-

- 1- S.D, Sharma, Operation Research,
- 2- F.S. Hiller and G.J. Lieberman, Industrial Engineering Series, 1995 (This book comes with a CD containing software)
- 3- G. Hadley , Linear Programming, Narosa Publishing House. 1995.
- 4- G. Hadley, Linear and Dynamic programming, Addison - Wesley
- 5- H.A. Taha, Operations Research - An introduction, Macmillan Publishing co. Inc. .
- 6- Prem Kumar Gupta and D.S. Hira, Operation Reasearch, an Introduction, S. Chand & Company Ltd.
- 7- B.Singh, Varsha Karanjaokar and R. S. Chandel, Operations Research, Golden Valley Publications.

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कक्षा Class : **M.Sc. (Mathematics)** **Theory Marks : 40**  
सेमेस्टर Semester : **IV** **C.C.E. Marks : 10**  
विषय समूह का शीर्षक Title of Subject : **Computational Biology -II**  
Group : **IV(2)**  
प्रश्न पत्र कं. Paper No. : **2**  
अनिवार्य/ वैकल्पिक Compulsory/ Optional : **Optional**

**Unit-1**

Integer programming, Partition Problems, Traveling Salesman Problem (TSP) simulated annealing Sequence.

**Unit-2**

Assembly - Sequencing strategies,

**Unit-3**

Traveling Salesman Problem (TSP) simulated annealing Sequence.

**Unit-4**

Fragment alignment, Sequence accuracy,

**Unit-5**

sequence comparisons Methods - Local and global alignment, Dynamic programming method.

**Text Books:-**

- 1-Introduction to Computational Biology by M.S, Waterman Chapman & Hall, 1995.
- 2-Bio informatics - A practical Guide to the analysis of Genes and Proteins by A. Baxeavanis and B. Ouelette, WileyInterscience (1998).

**Reference Books:-**

- 1- Introduction to Bio informatics by Attwood.
- 2- Bioinformatics-Sequence and Genome analysis by David W.Mount.

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अधिकतम अंक/Max. Marks 50

कक्षा Class :

M.Sc. (Mathematics)

Theory Marks : 40

सेमेस्टर Semester :

IV

C.C.E. Marks : 10

विषय समूह का शीर्षक Title of Subject : Jacobi Polynomial & H-Function-II

Group :

IV(3)

प्रश्न पत्र कं. Paper No. :

3

अनिवार्य/ वैकल्पिक Compulsory/ Optional : **Optional**

Unit-1

Differentiation formulas of H Function one Variable, Partial derivatives with respect to parameters. Contiguous relation and simple expansion formula.

Unit-2

The H Functions of two variables, Definition and notation. Asymptotic behavior elementary properties special cases.

Unit-3

Derivatives. Contiguous relations Total Count of recurrences.

Unit-4

Finite Summation formulas for the H Functions of two variables,

Unit-5

Method and schemes for obtaining sum of finite or infinite series. Double Summation formulas.

Books Recommended :

- 1- Rainville. E.D. : Special Functions. The Macmillan Co.. New. . 1971.
- 2- Shrivastava. H.M. , Gupta K.C. and Goyal. S.P. : The H- Functions of One and Two Variables with applications. South Asian Publication New .

Reference Books :

- 1- Lebedev. N.N. Special functions and Their Applications. Prentice Hall. Englewood Hall phase new jersey USA, 1965.
- 2- Whittaker. E.T, and Watson G.N. A Course of Modern analysis. Press. 1963

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अधिकतम अंक/Max. Marks 50

कक्षा Class : M.Sc. (Mathematics) Theory Marks : 40  
सेमेस्टर Semester : IV C.C.E. Marks : 10  
विषय समूह का शीर्षक Title of Subject : Fluid Mechanics-II  
Group : IV(4)  
प्रश्न पत्र कं. Paper No. : 4  
अनिवार्य/ वैकल्पिक Compulsory/ Optional : **Optional**

Unit-1

Motion of a sphere through agapsquid at rest as infinity. equation of motion of a sphere, stress components in a real fluid.

Unit-2

Relations between rectangular components of stress convection between streses and gradients of velocity,

Unit-3

plane Poiseuille and coquette flows between two parallel plate, flow through tubes of uniform, cross - section in the former of circle, annulus under constant pressure gradient.

Unit-4

Dynamical similarity, Reynolds number, Prandt's boundary layer, boundary layer equations in two dimension, blasius solution

Unit-5

boundary layer thickness, displacement thickness, Karman itegral conditions, separation of boundary layer flow.

Text Books.

- 1- A text book of Fluid Mechanics in SI units by R.K, Rajput.
- 2- An introduction to Fluid Dynamics by R.K. Rathy, Oxford and IBH Published Co.

Reference Books:

- 1- Fluid Mechanics (Springer) By Joseph H. Spurk.
- 2- Fluid Mechanics by Irfan A Khan (H.R.W.)
- 3- An Introduction to Fluid Mechanics by G.K. Batchelor, Foundation Books, , 1994.

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अधिकतम अंक/Max. Marks 50

कक्षा Class : M.Sc. (Mathematics)

Theory Marks : 40

सेमेस्टर Semester : IV

C.C.E. Marks : 10

विषय समूह का शीर्षक Title of Subject : Wavelets II

Group : V(1)

प्रश्न पत्र कं. Paper No. : 1

अनिवार्य/ वैकल्पिक Compulsory/ Optional : **Optional**

Unit-1

Inner products and orthogonal projection,

Unit-2

Applications of orthogonal projection to computer graphics, Computation of functions and wavelets, Discrete and fast Fourier transform with inverse and applications.

Unit-3

Fourier series for periodic functions its convergence and inversion, Unit-4 uniform convergence of Fourier series, Bessel's inequality, Parseval's inequality

Unit-5

The Fourier transform Convolution and inversion of Fourier transform Weight functions, approximate identities.

Text Books:-

- 1- Wavelets made easy by Y. Nieverregelt
- 2- A first Course on Wavelets by E. Hernandez and G. Weiss.

Reference Books.

- 1- An Introduction to Wavelets by Chui, Academic Press.

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अधिकतम अंक/Max. Marks 50

कक्षा Class : M.Sc. (Mathematics)

Theory Marks : 40

सेमेस्टर Semester : IV

C.C.E. Marks : 10

विषय समूह का शीर्षक Title of Subject : Bio-Mechanics-II

Group : V(2)

प्रश्न पत्र कं. Paper No. : 2

अनिवार्य/ वैकल्पिक Compulsory/ Optional : Optional

Unit-1

Solution of steady state and Unsteady - state flow problems in one dimension, application of finite element method and exact solutions.

Unit-2

Diffusion processes in biology ; diffusion in Tissue Fick's principle,

Unit-3

One, two and three Dimensional diffusion problems and their solution, Water Transport, Diffusion through membranes.

Unit-4

Respiratory Gas Flows, flow in Airways, Interaction Between convection and diffusion Exchange between Alveolar Gas and Erythrocytes,

Unit-5

Pulmonary function Test, Dynamics of Ventilation system.

Text books:

- 1- Introduction to Mathematical Biology by S.I. Rubinow, J. Wiley & Sons.
- 2- Biomechanics by Y.C, Fung, Springer - Verlag.
- 3- Introduction to Biomathematics by V.P. Saxena, Vishwa Prakashan (Wiley eastern)

Reference Book :-

- 1- Biofluid Dynamics by Mazumdar.

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अधिकतम अंक/Max. Marks 50

कक्षा Class : M.Sc. (Mathematics)  
सेमेस्टर Semester : IV  
विषय समूह का शीर्षक Title of Subject : Analytic Number Theory-II  
Group : V(3)  
प्रश्न पत्र कं. Paper No. : 3  
अनिवार्य/ वैकल्पिक Compulsory/ Optional : Optional

Theory Marks : 40  
C.C.E. Marks : 10

Unit-1

Dirichlet series and Euler products,

Unit-2

the function defined by Dirichlet series, the halfplane of convergence of a Dirichlet series.

Unit-3

Integral formula for the coefficients of Dirichlet series

Unit-4

Analytic properties of Dirichlet series, Mean value formula for Dirichlet series.

Unit-5

Properties of the gamma function, Integral representations of Hurwitz zeta functions, Analytic continuation of Hurwitz zeta function.

Book Recommended :

1- T.M. Apostol, Introduction to Analytic Number Theory, Narosa Pub, House, 1989.

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अधिकतम अंक/Max. Marks 50

कक्षा Class :

M.Sc. (Mathematics)

Theory Marks : 40

सेमेस्टर Semester :

V

C.C.E. Marks : 10

विषय समूह का शीर्षक Title of Subject : Integral Transform-II

Group :

V(4)

प्रश्न पत्र कं. Paper No. :

4

अनिवार्य/ वैकल्पिक Compulsory/ Optional : **Optional**

Unit-1

Application of Laplace Transform to Boundary Value Problems.

Unit-2

Electric Circuits. Application to Beams.

Unit-3

The complex Fourier Transform, Inversion Formula, Fourier cosine and sine transform,

Unit-4

properties of Fourier Transforms, Convolution & Parseval's identity

Unit-5

Fourier Transform of the derivatives, Finite Fourier Sine & Cosine Transform, Inversion Operational and combined properties Fourier transform.

Books recommended :-

[1] Integral Transforms by Goyal & Gupta.

[2] Integral Transforms by Sneddon

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अधिकतम अंक/Max. Marks 50

**Theory Marks : 25**

**C.C.E. Marks : 10**

**Practical Marks : 15**

कक्षा Class :

**M.Sc. (Mathematics)**

सेमेस्टर Semester :

**IV**

विषय समूह का शीर्षक Title of Subject :

**Fundamentals of Computer Science - II  
(Theory and Practical)**

Group :

**VI(1)**

प्रश्न पत्र कं. Paper No. :

**1**

अनिवार्य/ वैकल्पिक Compulsory/ Optional : **Optional**

**Unit 1 -**

Inheritance, Single Inheritance, Multilevel Inheritance, Multiple Inheritance, Hierarchical Inheritance, Hybrid Inheritance, Templates including Class Templates.

**Unit 2 -**

C++ Streams, C++ Stream Classes, put() and get() Functions, getline() and write() Functions.

**Unit 3 -**

Database Systems - Role of Database Systems, Database Systems Architecture.

**Unit 4 -**

SQL -Basic Features including views, Integrity Constraints, Key, Functional Dependency, Multivalued Functional Dependency, Database Design- Normalization up to BCNF.

**Unit 5 -**

Operating Systems - User Interface, Processor Mangement, Memory management , Network and Distributed Systems.

**Reference Books :**

- [1] E. Balagurusamy, Object Oriented Programming with C++, III Edition, Tata McGraw-Hill Publishing Company Limited, New Delhi.
- [1] S.B.Lipman , J Lajoi; C++ Primer Addison Wesley.
- [2] C.J. Date ; Introduction to Database systems, Addison Wesley.
- [3] C. Ritchie; Operating Systems, Incorporating UNIX and Windows, BPB Publications.

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अधिकतम अंक/Max. Marks 50

कक्षा Class :

M.Sc. (Mathematics)

Theory Marks : 40

सेमेस्टर Semester :

IV

C.C.E. Marks : 10

विषय समूह का शीर्षक Title of Subject : Mathematics of Finance & Insurance -II

Group :

VI(2)

प्रश्न पत्र कं. Paper No. :

2

अनिवार्य/ वैकल्पिक Compulsory/ Optional : **Optional**

Unit-1

A Brief introduction to financial Markets,

Unit-2

basics of Securities, Stocks Bonds and financial derivatives,

Unit-3

Viz forwards, Futures, Options and Swaps.

Unit-4

An Introduction to stochastic Calculus stochastic process, geometric Brownian motion stochastic integration and Ito's lemma

Unit-5

Option Pricing models- Binomial Models and Black Scholes Option Pricing Model for European Options, Black Scholes formula and computation of greeks.

Text Books:

Options, Futures and other Derivatives by Jhon C. Hull Prentice -Hall of India Pvt. Ltd. An introduction to Mathematic Finance by Cheldon M. Ross, Cambridge University Press.

Reference Books:

An Introduction to Mathematics of Financial Derivatives by Salih N. Neftci, Academic Press, Inc. mathematics of Financial markets by Ribert J. Elliot & P.E. Kopp Springer Verlag, New York Inc.

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अधिकतम अंक/Max. Marks 50

कक्षा Class : **M.Sc. (Mathematics)** **Theory Marks : 40**  
सेमेस्टर Semester : **IV** **C.C.E. Marks : 10**  
विषय समूह का शीर्षक Title of Subject : **Spherical Trigonometry and astronomy-II**  
Group : **VI(3)**  
प्रश्न पत्र कं. Paper No. : **3**  
अनिवार्य/ वैकल्पिक Compulsory/ Optional : **Optional**

Unit-1

Spherical Astronomy - Various system of references and related topics.

Unit-2

Celestial sphere,

Unit-3

Transit instrument. Atmospheric Refraction. Time planetary phenomena.

Unit-4

Atmospheric Refraction.

Unit-5

Time planetary phenomena.

Text Books:-

- 1- A text book of spherical trigonometry : Gorakh Prasad.
- 2- A text book of spherical Astronomy : Gorakh Prasad.

Reference Book.

- 1- Spherical Astronomy - Smarat
- 2- spherical Astronomy - Bell

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