# HEMCHAND YADAV VISHWAVIDYALAYA, DURG (C.G.)

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# SCHEME OF EXAMINATION
# &
# SYLLABUS
# of
# M.A./M.Sc.(Mathematics) Semester Exam

**UNDER**

# FACULTY OF SCIENCE

**Session 2023-24 & 2024-25**

**(Approved by Board of Studies)**
**Effective from June 2023**

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M.A./M.Sc. (MATHEMATICS)
Semester-I (Code-209)
2023-24

There shall be five papers. Each paper shall have 100 marks. **Overall tally of marks will be 500.**

| Paper | Description | Theory | Sessional | Practical | Total Marks | Credit |
|---|---|---|---|---|---|---|
| I | Advanced Abstract Algebra (I) | 80 | 20 | - | 100 | 05 |
| II | Real Analysis (I) | 80 | 20 | -- | 100 | 05 |
| III | Topology | 80 | 20 | -- | 100 | 05 |
| IV | Advanced Complex Analysis (I) | 80 | 20 | -- | 100 | 05 |
| V | Advanced Discrete Mathematics (I) | 80 | 20 | -- | 100 | 05 |

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## M.Sc. /M.A. Course (First Semester)

### PAPER -I (Code - 209101)

## Advanced Abstract Algebra (I)

Max. Marks 80

**Unit-I** Groups - Normal and Subnormal series. Composition series. Jordan-Holder theorem. Solvable groups. Nilpotent groups.

**Unit-II** Field theory- Extension fields. Algebraic and transcendental extensions. Separable and inseparable extensions. Algebraically closed fields.

**Unit-III** Perfect fields. Finite fields. Primitive elements. Normal extensions, Splitting field.

**Unit-IV** Automorphisms of extensions. Galois extensions. Fundamental theorem of Galois theory.

**Unit-V** Solution of polynomial equations by radicals. Insolvability of the general equation of degree 5 by radicals.

**Books Recommended:**


1. P. B. Bhattacharya, S. K. Jain, S. R. Nagpaul: Basic Abstract Algebra, Cambridge University press
2. I. N. Herstein: Topics in Algebra, Wiley Eastern Ltd.


**References**


1. M. Artin, Algebra, Prentice -Hall of India, 1991.
2. P. M. Cohn, Algebra, Vols. I, II &III, John Wiley & Sons, 1982, 1989, 1991.
3. N. Jacobson, Basic Algebra, Vols. I , W.H. Freeman, 1980 (also published by Hindustan Publishing Company).
4. S. Lang, Algebra, 3rd edition, Addison-Wesley, 1993.
5. I. S. Luther and I. B. S. Passi, Algebra, Vol. I-Groups, Vol.II-Rings, Narosa Publishing House (Vol.l-1996,Vol. II-1999)
6. D. S. Malik, J. N. Mordeson, and M. K. Sen, Fundamentals of Abstract Algebra, Mc Graw-Hill, International Edition, 1997.
7. Qazi Zameeruddin and Surjeet Singh : Modern Algebra
8. I. Stewart, Galois theory, 2nd edition, Chapman and Hall, 1989.
9. J. P. Escofier, Galois theory, GTM Vol.204, Springer, 2001..
10. Fraleigh , A first course in Algebra Algebra, Narosa,1982.
11. Vivek Sahai and Vikas Bist: Algebra, Narosa Publishing House, 1999.


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# M.Sc. /M.A. Course (First Semester)

## PAPER-II (Code - 209102)

## Real Analysis (I)

Max. Marks 80

**Unit-I** Sequences and series of functions, pointwise and uniform convergence, Cauchy criterion for uniform convergence, Weierstrass M-test, Abel's and Dirichlet's tests for uniform convergence, uniform convergence and continuity, definition and simple properties of Riemann-Stieltjes integral, uniform convergence and Riemann-Stieltjes integration, uniform convergence and differentiation, Weierstrass approximation theorem.

**Unit-II** Power series, uniqueness theorem for power series, Abel's and Tauber's theorems. Rearrangements of terms of a series, Riemann's theorem.

**Unit-III** Functions of several variables, linear transformations, Derivatives in an open subset of $R^n$, Chain rule, Partial derivatives, interchange of the order of differentiation, Derivatives of higher orders, Taylor's theorem, Inverse function theorem, Implicit function theorem.

**Unit-IV** Jacobians, extremum problems with constraints, Lagrange's multiplier method, Differentiation of integrals.

**Unit-V** Partitions of unity, Differential forms, Stoke's theorem.

**Recommended Books**:


1. Principle of Mathematical Analysis by Walter Rudin (3rd edition) McGraw-Hill, Kogakusha, 1976, International student edition.
2. Real Analysis by H. L. Roydon, Macmillan Pub. Co. Inc. 4th Edition, New York .1962.


**References**


1. T. M. Apostol, Mathematical Analysis, Narosa Publishing House, New Delhi, 1985.
2. Gabriel Klambauer, Mathematical Analysis, Marcel Dekkar,Inc. New York, 1975.
3. A. J. White, Real Analysis; an introduction, Addison-Wesley Publishing Co., Inc.,1968.
4. G. de Barra, Measure Theory and Integration, Wiley Eastern Limited, 1981.
5. E. Hewitt and K. Stromberg. Real and Abstract Analysis, Berlin, Springer, 1969.


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6. P. K. Jain and V.P. Gupta, Lebesgue Measure and Integration, New Age International (P) Limited Published, New Delhi, 1986 Reprint 2000).
7. I. P. Natanson, Theory of Functions of a Real Variable. Vol. l, Frederick Ungar Publishing Co., 1961.
8. Richard L. Wheeden and Antoni Zygmund, Measure and Integral: An Introduction to Real Analysis, Marcel Dekker Inc.1977.
9. J. H. Williamson, Lebesgue Integration, Holt Rinehart and Winston, Inc. New York. 1962.
10. A. Friedman, Foundations of Modern Analysis, Holt, Rinehart and Winston, Inc., New York, 1970.
11. P. R. Halmos, Measure Theory, Van Nostrand, Princeton, 1950.
12. T. G. Hawkins, Lebesgue's Theory, of Integration: Its Origins and Development, Chelsea, New York, 1979.
13. K. R. Parthasarathy, Introduction to Probability and Measure, Macmillan Company of India Ltd., Delhi, 1977.
14. R. G. Bartle, The Elements of Integration, John Wiley & Sons, Inc. New York, 1966.
15. Serge Lang, Analysis I & II, Addison-Wesley Publishing Company, Inc. 1969.
16. Inder K. Rana, An Introduction to Measure and Integration, Norosa Publishing House, Delhi, 1997.
17. Walter Rudin, Real & Complex Analysis, Tata McGraw-Hill Publishing Co.Ltd. New Delhi, 1966.

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# M.Sc. /M.A. Course (First Semester)

## PAPER-III (Code - 209103)

## Topology

Max. Marks 80

**Unit-I** Countable and uncountable sets. Infinite sets a n d 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. Definition and examples of topological spaces. Closed sets. Closure. Dense subsets. Neighbourhoods. Interior, exterior and boundary. Accumulation points and derived sets. Bases and sub-bases. Subspaces and relative topology.

**Unit-II** Alternate methods of defining a topology in terms of Kuratowski Closure Operator and Neighborhood Systems. Continuous functions and homeomorphism. First and Second Countable spaces. Lindelof's theorems. Separable spaces. Second countability and separability.

**Unit-III** Separation axioms; their Characterizations and basic properties. Urysohn's lemma, Tietze extension theorem.

**Unit-IV** 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-V** Compactness in metric spaces. Equivalence of compactness, countable compactness and sequential compactness in metric space. Connected spaces. Connectedness on the real line. Components. Locally connected spaces.

**Recommended Books**:

1. K. D. Joshi, Introduction to General Topology, Wiley Eastern Ltd., 1983.

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**References**


1. J. Dugundji, Topology, Allyn and Bacon, 1966 (reprinted in India by Prentice Hall of India Pvt. Ltd.).
2. George F.Simmons, Introduction to Topology and modern Analysis, McGraw-Hill Book Company, 1963.
3. J. Hocking and G Young, Topology, Addison-Wiley Reading, 1961.
4. J. L. Kelley, General Topology, Van Nostrand, Reinhold Co., New York,1995.
5. L. Steen and J. Seebach, Counter examples in Topology, Holt, Rinehart and Winston, New York, 1970.
6. W. Thron, Topologically Structures, Holt, Rinehart and Winston, New York,1966.
7. N. Bourbaki, General Topology Part I (Transl.),Addison Wesley, Reading, 1966.
8. R. Engelking, General Topology, Polish Scientific Publishers, Warszawa, 1977.
9. W. J. Pervin, Foundations of General Topology, Academic Press Inc. New York, 1964.
10. E. H. Spanier, Algebraic Topology, McGraw-Hill, New York, 1966.
11. S. Willard, General Topology, Addison-Wesley, Reading, 1970.
12. Crump W.Baker, Introduction to Topology, Wm C. Brown Publisher, 1991.
13. Sze-Tsen Hu, Elements of General Topology, Holden-Day, Inc.1965.
14. D. Bushaw, Elements of General Topology, John Wiley & Sons, New York, 1963.
15. M. J. Mansfield, Introduction to Topology, D.Van Nostrand Co. Inc. Princeton, N. J.,1963.
16. B. Mendelson, Introduction to Topology, Allyn & Bacon, Inc., Boston, 1962.
17. C. Berge, Topological Spaces, Macmillan Company, New York, 1963.
18. S. S. Coirns, Introductory Topology, Ronald Press, New York, 1961.
19. Z. P. Mamuzic, Introduction to General Topology, P. Noordhoff Ltd.,Groningen, 1963.
20. K. K. Jha, Advanced General Topology, Nav Bharat Prakashan, Delhi.
21. James R. Munkres, Topology, A First Course, Prentice Hall of India Pvt. Ltd., New Delhi, 2000.


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# M.Sc./M.A. Course (First Semester)

**PAPER-IV (Code - 209104)**

## Advance Complex Analysis (I)

Max. Marks 80

**Unit-I** Complex integration, Cauchy-Goursat. Theorem. Cauchy's integral formula. Higher order derivatives. Morera's Theorem. Cauchy's inequality and Liouville's theorem. The fundamental theorem of algebra. Taylor's theorem. Laurent's series. Isolated singularities. Meromorphic functions.

**Unit-II** Maximum modulus principle. Schwarz lemma. The argument principle. Rouche's theorem Inverse function theorem.

**Unit-III** Residues. Cauchy's residue theorem. Evaluation of integrals. Branches of many valued functions with special reference to arg z, logz and $z^a$.

**Unit-IV** Definitions and examples of conformal mapping Bilinear transformations, their properties and classifications.

**Unit-V** Spaces of analytic functions. Hurwitz's theorem. Montel's theorem Riemann mapping theorem.

**Recommended Books:**


1. Complex Analysis by L.V. Ahlfors, McGraw - Hill, 1979.
2. J. B. Conway, Functions of one Complex variable, Springer-Verlag, International student-Edition, Narosa Publishing House, 1980.
3. H. K. Pathak, Complex Analysis and Applications, Springer, 2019


**References**


1. H. A. Priestly, Introduction to Complex Analysis, Clarendon Press, Oxford 1990.
2. Complex Function Theory By D. Sarason
3. Liang-shin Hahn & Bernard Epstein, Classical Complex Analysis, Jones and Bartlett Publishers International, London, 1996.
4. S. Lang, Complex Analysis, Addison Wesley, 1977.
5. D. Sarason, Complex Function Theory, Hindustan Book Agency, Delhi, 1994.
6. Mark J. Ablowitz and A.S. Fokas, Complex Variables: Introduction and Applications, Cambridge University press, South Asian Edition, 1998.


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7. E. Hille, Analytic Function Theory (2 Vols.) Gonn & Co., 1959.

8. W. H. J. Fuchs, Topics in the Theory of Functions of one Complex Variable, D.Van Nostrand Co., 1967.

9. C. Caratheodory, Theory of Functions (2 Vols.) Chelsea Publishing Company, 1964.

10. M.Heins, Complex Function Theory, Academic Press, 1968.

11. Walter Rudin, Real and Complex Analysis, McGraw-Hill Book Co., 1966.

12. S. Saks and A.Zygmund, Analytic Functions, Monografic Matematyczne, 1952.

13. E. C. Titchmarsh, The Theory of Functions, Oxford University Press, London.

14. W. A. Veech, A Second Course in Complex Analysis, W.A. Benjamin, 1967.

15. S. Ponnusamy, Foundations of Complex Analysis, Narosa Publishing House, 1997.

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# M.Sc./M.A. Course (First Semester)

## PAPER-V (Code - 209105)

## Advanced Discrete Mathematics (I)

Max. Marks 80

**Unit-I** Formal Logic-Statements. Symbolic Representation and Tautologies. Quantifiers, Predicates and Validity. Propositional Logic. Semigroups & Monoids-Definitions and Examples of Semigroups and monoids (including those pertaining to concatenation operation).

**Unit-II** Homomorphism of semigroups and monoids. Congruence relation and Quotient Semigroups. Subsemigroup and submonoids. Direct Products. Basic Homomorphism Theorem.

**Unit-III** 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. Boolean Algebras-Boolean Algebras as Lattices. Various Boolean Identities. The Switching Algebra example. Subalgebras,

**Unit-IV** 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-V** Grammars and Languages-Phrase-Structure Grammars. Rewriting Rules. Derivations. Sentential Forms. Language generated by a Grammar. Regular, Context-Free, and Context Sensitive Grammars and Languages. Regular sets, Regular Expressions and the Pumping Lemma. Kleene's Theorem. Notions of Syntax Analysis, Polish Notations. Conversion of Infix Expressions to Polish Notations. The Reverse Polish Notation.

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**Recommended Books**:

1. C. L Liu, Elements of Discrete Mathematics, McGraw-Hill Book Co.
2. J. P. Tremblay & R. Manohar, Discrete Mathematical Structures with Applications to Computer Science, McGraw-Hill Book Co., 1997.
3. Discrete Mathematics, Babu Ram, Pearson Education India, 2012.

**References**


1. J. L. Gersting, Mathematical Structures for Computer Science, (3rd edition), Computer Science Press, New York.
2. Seymour Lepschutz, 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. Hop croft and J. D Ullman, Introduction to Automata Theory, Languages & Computation, Narosa Publishing House.
5. N. Deo. Graph Theory with Application to Engineering and Computer Sciences. Prentice Hall of India
6. K. L. P .Mishra and N. Chandrashekaran, Theory of Computer Science PHI(2002)
7. Discrete Mathematics and it's Applications, Kenneth H. Rosen, Mc Graw Hill.


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# HEMCHAND YADAV VISHWAVIDYALAYA, DURG (C.G.)

## M.A. /M.Sc. (MATHEMATICS)

**(Semester-II)** (Code - 210)
**2023-24 & Onward**

There shall be five theory papers. Each paper shall have 100 marks.

**Overall tally of marks will be 500.**

| Paper | Description | Theory | Sessional | Practical | Total Marks | Credit |
|---|---|---|---|---|---|---|
| I | Advanced Abstract Algebra (II) | 80 | 20 | - | 100 | 05 |
| II | Real Analysis (II) | 80 | 20 | -- | 100 | 05 |
| III | General and Algebraic Topology | 80 | 20 | -- | 100 | 05 |
| IV | Advanced Complex Analysis (II) | 80 | 20 | -- | 100 | 05 |
| V | Advanced Discrete Mathematics (II) | 80 | 20 | -- | 100 | 05 |

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# HEMCHAND YADAV VISHWAVIDYALAYA, DURG (C.G.)

## M.Sc. /M.A. Course (Second Semester)

**PAPER-I** (Code - 210201)

## Advanced Abstract Algebra (II)

Max. Marks 80

**Unit-I** Modules - Cyclic modules. Simple modules. Semi-simple modules. Schuler's Lemma. Free modules. Noetherian and Artinian modules and rings-Hilbert basis theorem. Wedderburn Artin theorem. Uniform modules, primary modules, and Noether-Lasker theorem.

**Unit-II** Linear Transformations - Algebra of linear transformation, Singular and non singular transformation, characteristic roots and vectors, matrices and linear transformations.

**Unit-III** Canonical Forms - Similarity of linear transformations. Invariant subspaces. Reduction to triangular forms. Nilpotent transformations. Index of nilpotency. Invariants of a nilpotent transformation. The primary decomposition theorem. Jordan blocks and Jordan forms.

**Unit-IV** Smith normal form over a principal ideal domain and rank. Fundamental structure theorem for finitely generated modules over a Principal ideal domain and its applications to finitely generated abelian groups.

**Unit-V** Rational canonical from. Generalised Jordan form over any field.

**Books Recommended:**


1. P. B. Bhattacharya, S.K.Jain, S.R.Nagpaul : Basic Abstract Algebra, Cambridge University press
2. I. N. Herstein : Topics in Algebra, Wiley Eastern Ltd.
3. Qazi Zameeruddin and Surjeet Singh : Modern Algebra


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**References**


1. M. Artin, Algebra, Prentice -Hall of India, 1991.
2. P. M. Cohn, Algebra,Vols. I, II &III, John Wiley & Sons, 1982, 1989, 1991.
3. N. Jacobson, Basic Algebra, Vols. I & II, W. H. Freeman, 1980 (also published by Hindustan Publishing Company).
4. S. Lang, Algebra, 3rd edition, Addison-Wesley, 1993.
5. I. S. Luther and I.B.S. Passi, Algebra, Vol. I-Groups, Vol.II-Rings, Narosa Publishing House (Vol.l-1996,Vol. II-1999)
6. D. S.Malik, J.N.Mordeson, and M.K.Sen, Fundamentals of Abstract Algebra, Mc Graw-Hill, International Edition, 1997.
7. K. B. Datta, Matrix and Linear Algebra, Prentice Hall of India Pvt. Ltd., New Delhi, 2000.
8. S. K. Jain,A. Gunawardena and P.B Bhattacharya, Basic Linear Algebra with MATLAB, Key College Publishing (Springer-Verlag),2001.
9. S. Kumaresan, Linear Algebra, A Geometric Approach, Prentice-Hall of India, 2000.
10. Vivek Sahai and Vikas Bist, Algebra, Narosa Publishing House, 1999.
11. I. Stewart, Galois Theory, 2nd edition, chapman and Hall, 1989.
12. J. P. Escofier, Galois Theory, GTM Vol.204, Springer, 2001.
13. T. Y. Lam, Lectures on Modules and Rings, GTM Vol. 189, Springer-Verlag,1999.
14. D. S. Passman, A Course in Ring Theory, Wadsworth and Brooks/Cole Advanced Books and Softwares, Pacific groves. California, 1991.
15. Fraleigh , A first course in Algebra Algebra, Narosa, 1982.


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# M.Sc./M.A. Course (Second Semester)

**PAPER-II (Code - 210202)**

## Real Analysis (II)

Max. Marks 80

**Unit-I** Definition and existence of Riemann-Stieltjes integral, Properties of the Integral, integration and differentiation, the fundamental theorem of Calculus, integration of vector-valued functions, Rectifiable curves.

**Unit-II** Lebesgue outer measure. Measurable sets. Regularity. Measurable functions. Borel and Lebesgue measurability. Non-measurable sets. Integration of Non-negative functions. The General integral. Integration of Series.

**Unit-III** Measures and outer measures, Extension of a measure. Uniqueness of Extension. Completion of a measure. Measure spaces. Integration with respect to a measure. Reimann and Lebesgue Integrals.

**Unit-IV** The Four derivatives. Lebesgue Differentiation Theorem. Differentiation and Integration.

**Unit-V** Functions of Bounded variation. The $L^p$-spaces. Convex functions. Jensen's inequality. Holder and Minkowski inequalities. Completeness of $L^p$, Convergence in Measure, Almost uniform convergence.

**Recommended Books**:

1. Principle of Mathematical Analysis by W. Rudin
2. Real Analysis by H. L. Roydon

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**References**


1. T. M. Apostol, Mathematical Analysis, Narosa Publishing House, New Delhi, 1985.
2. Gabriel Klambauer, Mathematical Analysis, Marcel Dekkar,Inc. New York,1975.
3. A. J. White, Real Analysis; an introduction, Addison-Wesley Publishing Co., Inc., 1968.
4. G. de Barra, Measure Theory and Integration, Wiley Eastern Limited, 1981.
5. E. Hewitt and K. Stromberg. Real and Abstract Analysis, Berlin, Springer, 1969.
6. P. K. Jain and V.P. Gupta, Lebesgue Measure and Integration, New Age International (P) Limited Published, New Delhi, 1986 Reprint 2000).
7. I. P. Natanson, Theory of Functions of a Real Variable. Vol. l, Frederick Ungar Publishing Co., 1961.
9. Richard L. Wheeden and Antoni Zygmund, Measure and Integral: An Introduction to Real Analysis, Marcel Dekker Inc.1977.
10. J. H. Williamson, Lebesgue Integration, Holt Rinehart and Winston, Inc. New York. 1962.
11. A. Friedman, Foundations of Modern Analysis, Holt, Rinehart and Winston, Inc., New York, 1970.
12. P. R. Halmos, Measure Theory, Van Nostrand, Princeton, 1950.
13. T. G. Hawkins, Lebesgue's Theory, of Integration: Its Origins and Development, Chelsea, New York, 1979.
14. K. R. Parthasarathy, Introduction to Probability and Measure, Macmillan Company of India Ltd., Delhi, 1977.
15. R.G. Bartle, The Elements of Integration, John Wiley & Sons, Inc. New York, 1966.
16. Serge Lang, Analysis I & II, Addison-Wesley Publishing Company, Inc. 1969.
17. Inder K. Rana, An Introduction to Measure and Integration, Norosa Publishing House, Delhi, 1997.


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# M.Sc./M.A. Course (Second Semester)

## PAPER-III (Code - 210203)

### General and Algebraic Topology

Max. Marks 80

**Unit-I** Tychonoff product topology in terms of standard sub-base and its characterizations. Projection maps.

**Unit-II** Product spaces, separation axioms connectedness (Tychonoff's theorem). Compactness , product spaces Countability in product spaces.

**Unit-III** Embedding and metrization. Embedding lemma and Tychonoff embedding. The Urysohn metrization theorem. Metrization theorems and Paracompactness-Local finiteness. The Nagata-Smirnov metrization theorem. Paracompactness. The Smirnov metrization theorem.

**Unit-IV** Nets and filter. 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. Ultra-filters and Compactness.

**Unit-V** 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, Wiley Eastern Ltd., 1983.


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**References**


1. J. Dugundji, Topology, Allyn and Bacon, 1966 (reprinted in India by Prentice Hall of India Pvt. Ltd.).
2. George F.Simmons, Introduction to Topology and modern Analysis, McGraw-Hill Book Company, 1963.
3. J. Hocking and G Young, Topology, Addison-Wiley Reading, 1961.
4. J. L. Kelley, General Topology, Van Nostrand, Reinhold Co., New York,1995.
5. L. Steen and J. Seebach, Counter examples in Topology, Holt, Rinehart and Winston, New York, 1970.
6. W. Thron, Topologically Structures, Holt, Rinehart and Winston, New York,1966.
7. N. Bourbaki, General Topology Part I (Transl.),Addison Wesley, Reading, 1966.
8. R. Engelking, General Topology, Polish Scientific Publishers, Warszawa, 1977.
9. W. J. Pervin, Foundations of General Topology, Academic Press Inc. New York,1964.
10. E. H. Spanier, Algebraic Topology, McGraw-Hill, New York,1966.
11. S. Willard, General Topology, Addison-Wesley, Reading, 1970.
12. Crump W.Baker, Introduction to Topology, Wm C. Brown Publisher, 1991.
13. Sze-Tsen Hu, Elements of General Topology, Holden-Day,Inc.1965.
14. D. Bushaw, Elements of General Topology, John Wiley & Sons, New York, 1963.
15. M. J. Mansfield, Introduction to Topology, D.Van Nostrand Co. Inc.Princeton,N.J.,1963.
16. B. Mendelson, Introduction to Topology, Allyn & Bacon, Inc., Boston,1962.
17. C. Berge, Topological Spaces, Macmillan Company, New York,1963.
18. S. S. Coirns, Introductory Topology, Ronald Press, New York, 1961.
19. Z. P. Mamuzic, Introduction to General Topology, P. Noordhoff Ltd.,Groningen, 1963.
20. K. K. Jha, Advanced General Topology, Nav Bharat Prakashan, Delhi.


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# M.Sc. / M.A. Course (Second Semester)

**PAPER-IV (Code - 210204)**

## Advanced Complex Analysis (II)

Max. Marks 80

**Unit-I** Weierstrass' factorisation theorem. Gamma function and its properties. Riemann Zeta function. Riemann's functional equation. Runge's theorem. Mittag-Leffler's theorem.

**Unit-II** Analytic Continuation. Uniqueness of direct analytic continuation. Uniqueness of analytic continuation along a curve. Power series method of analytic continuation Schwarz Reflection Principle. Monodromy theorem and its consequences.

**Unit-III** Harmonic functions on a disk. Harnack's inequality and theorem. Dirichlet Problem. Green's function.

**Unit-IV** 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-V** The range of an analytic function. Bloch's theorem. The Little Picard theorem. Schottky's theorem. Montel Caratheodory and The Great Picard theorem. Univalent functions. Bieberbach's conjecture (Statement only) and the "1/4-theorem.

**Recommended Books**:


1. L. V. Ahlfors, Complex Analysis, MCGraw - Hill, 1979.
2. J. B. Conway, Functions of one Complex variable, Springer-Verlag, International student-Edition, Narosa Publishing House,1980.
3. H. K. Pathak, Complex Analysis and Applications, Springer, 2019


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**References**


1. H. A. Priestly, Introduction to Complex Analysis, Clarendon Press, Oxford 1990.
2. Liang-shin Hahn & Bernard Epstein, Classical Complex Analysis, Jones and Bartlett Publishers International, London, 1996.
3. S. Lang, Complex Analysis, Addison Wesley, 1977.
4. Mark J.Ablowitz and A.S. Fokas, Complex Variables: Introduction and Applications, Cambridge University press, South Asian Edition, 1998.
5. E. Hille, Analytic Function Theory (2 Vols.) Gonn & Co., 1959.
6. W. H. J. Fuchs, Topics in the Theory of Functions of one Complex Variable, D.Van Nostrand Co., 1967.
7. C. Caratheodory, Theory of Functions (2 Vols.) Chelsea Publishing Company, 1964.
8. M. Heins, Complex Function Theory, Academic Press, 1968.
9. Walter Rudin, Real and Complex Analysis, McGraw-Hill Book Co., 1966.
10. S. Saks and A. Zygmund, Analytic Functions, Monografic Matematyczne, 1952.
11. E.C Titchmarsh, The Theory of Functions, Oxford University Press, London.
12. W. A. Veech, A Second Course in Complex Analysis, W.A. Benjamin, 1967.
13. S. Ponnusamy, Foundations of Complex Analysis, Narosa Publishing House, 1997.
14. D. Sarason, Complex Function Theory, Hindustan Book Agency, Delhi, 1994.


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# M.Sc. /M.A. Course (Second Semester)
## PAPER-V (Code - 210205)
## Advanced Discrete Mathematics (II)

Max. Marks 80

**Unit-I** Graph Theory-Definition of (Undirected) Graphs, Paths, Circuits, Cycles, & Subgraphs. Induced Subgraphs. Degree of a vertex. Connectivity. Planar Graphs and their properties. Trees. Euler's Formula for connected planar Graphs. Complete & Complete Bipartite Graphs. Kuratowski's Theorem (statement only) and its use.

**Unit-II** Spanning Trees, Cut-sets, Fundamental Cut -sets, and Cycle. Minimal Spanning Trees and Kruskal's Algorithm. Matrix Representations of Graphs. Euler's Theorem on the Existence of Eulerian Paths and Circuits.

**Unit-III** Directed Graphs. In degree and Out degree of a Vertex. Weighted undirected Graphs. Dijkstra's Algorithm.. strong Connectivity & Warshall's Algorithm. Directed Trees. Search Trees. Tree Traversals.

**Unit-IV** Introductory Computability Theory-Finite State Machines and their Transition Table Diagrams. Equivalence of finite State Machines. Reduced Machines. Homomorphism.

**Unit-V** Finite Automata. Acceptors. Non-deterministic Finite Automata and equivalence of its power to that of Deterministic Finite Automata. Moore and mealy Machines. Turing Machine and Partial Recursive Functions.

**Recommended Books**:


1. Elements of Discrete Mathematics By C. L. Liu. Mc Grew Hill Book Co.
2. Graph Theory and its application By N. Deo, Prentice Hall of India
3. Theory of Computer Science By K. L. P. Mishra and N. Chandrashekaran, Prentice Hall of India, New Delhi
4. Discrete Mathematics, Babu Ram, Pearson Education India, 2012.


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**References**


1. J. P. Tremblay & R. Manohar, Discrete Mathematical Structures with Applications to Computer Science, McGraw-Hill Book Co., 1997.
2. J. L. Gersting, Mathematical Structures for Computer Science, (3rd edition), Computer Science Press, New York.
3. Seymour Lepschutz, Finite Mathematics (International) edition 1983), McGraw-Hill Book Company, New York.
4. S. Wiitala, Discrete Mathematics-A Unified Approach, McGraw-Hill Book Co.
5. J. E. Hopcroft and J. D. Ullman, Introduction to Automata Theory, Languages & Computation, Narosa Publishing House.
6. C.L Liu, Elements of Discrete Mathematics, McGraw-Hill Book Co.
7. N. Deo. Graph Theory with Application to Engineering and Computer Sciences. Prentice Hall of India.


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# HEMCHAND YADAV VISHWAVIDYALAYA, DURG (C.G.)

## M.A./M.Sc. (MATHEMATICS)

## (Semester-III) (Code - 211)

## 2024-25 & Onward

There shall be five theory papers. Two compulsory and three optional. Each paper shall have 100 marks. Out of these five papers, the paper which has theory and practical both, the theory part shall have 70 marks and practical part shall have 30 marks. **Overall tally of marks in theory and practical will be 500.**

| Paper | | Description | Theory | Sessional | Practical | Remark | Credit |
|---|---|---|---|---|---|---|---|
| **Compulsory Papers** | | | | | | | |
| I | | Integration Theory and Functional Analysis (I) | 80 | 20 | -- | -- | 05 |
| II | | Partial Differential Equations | 80 | 20 | -- | -- | 05 |
| **Optional Papers** | | | | | | | |
| III | A | Fundamentals of Computer Science (Object Oriented Programming and Data Structure)<br>Maths Lab-I | 70 | -- | 30 | For regular students only | 03<br>02 |
| | B | General Relativity and Cosmology (I) | 80 | 20 | -- | -- | 05 |
| | C | Fuzzy Set Theory & Its Applications (I) | 80 | 20 | -- | -- | 05 |
| | D | Mathematical Biology (I) | 80 | 20 | -- | -- | 05 |
| IV | A | Operations Research (I) | 80 | 20 | -- | -- | 05 |
| | B | Wavelets (I) | 80 | 20 | -- | -- | 05 |
| V | A | Programming in C (with ANSI Features) (I)<br>Maths Lab-II | 70 | -- | 30 | For regular students only | 03<br>02 |
| | B | Graph Theory (I) | 80 | 20 | -- | -- | 05 |
| | C | Algebraic Number Theory (I) | 80 | 20 | -- | -- | 05 |

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# HEMCHAND YADAV VISHWAVIDYALAYA, DURG (C.G.)

## M.Sc./M.A. Course (Third Semester)

### PAPER -I (Code - 211301)

### Integration Theory and Functional Analysis (I)

Max. Marks 80

## Integration Theory:

**Unit-I** Signed measure. Hahn decomposition theorem, mutually singular measures. Radon-Nikodym theorem. Labesgue decomposition. Riesz representation theorem. Extension theorem (Caratheodory).

**Unit-II** Lebesgue-Stieltjes integral, product measures, Fubini's theorem. Differentiation and Integration. Decomposition into absolutely continuous and singular parts.

## Functional Analysis:

**Unit-III** Normed linear spaces. Banach spaces and examples. Quotient space of normed linear spaces and its completeness, equivalent norms. Riesz Lemma, basic properties of finite dimensional normed linear spaces and compactness.

**Unit-IV** Weak convergence and bounded linear transformations, normed linear spaces of bounded linear transformations, dual spaces with examples.

**Unit-V** Contraction mapping theorem and its application, Banach fixed point theorem, Picard's theorem, Banach fixed point theorem as a source of existence and uniqueness theorem for integral equations, Nonlinear operator, examples convex function, epigraph, monotone mapping, α-monotone, coercive mapping duality maps.

## Books Recommended :


1. P. R. Halmos, Measure Theory, Van Nostrand, Princeton, 1950.
2. B. Choudhary and S.Nanda, Functional Analysis with Applications. Wiley Eastern Ltd. 1989.
3. H. L. Royden, Real Analysis, Macmillan Publishing Co. Inc., New York, 4'h Edition, 1993.


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## References


1. S. K. Berberian, Measure and integration, Chelsea Publishing Company, New York, 1965.
2. G. de Barra, Measure Theory and Integration, Wiley Eastern Limited, 1981.
3. P. K. Jain and V.P. Gupta, Lebesgue Measure and Integration, New Age International (P) Limited, New Delhi, 2000.
4. Richard L. Wheeden and Antoni Zygmund, Measure and Integral : An Introduction to Real Analysis, Marcel Dekker Inc. 1977.
5. J. H. Williamson, Lebesgue Integration, Holt Rinehart and Winston, Inc. New York. 1962.
6. T. G. Hawkins, Lebesgue's Theory of Integration: Its Origins and Development, Chelsea, New York, 1979.
7. K. R. Parthasarathy, Introduction to Probability and Measure, Macmillan Company of India Ltd., Delhi, 1977.
8. R. G. Bartle, The Elements of Integration, John Wiley & Sons, Inc. New York, 1966.
9. Serge Lang, Analysis I & II, Addison-Wesley Publishing Company, Inc. 1967.
10. Inder K. Rana, An Introduction to Measure and Integration, Narosa Publishing House, Delhi, 1997.
11. Walter Rudin, Real & Complex Analysis, Tata McGraw-Hill Publishing.
12. Edwin Hewitt and Korl Stromberg, Real and Abstract Analysis, Springer-Verlag, New York.
13. Edwin Hewitt and Kenneth A. Ross, Abstract Harmonic Analysis, Vol. 1, Springer-Verlag, 1993.
14. G. Bachman and L. Narici, Functional Analysis, Academic Press, 1966.
15. N. Dunford and J.T. Schwartz, Linear Operators, Part I, Interscience, New York, 1958.
16. R. E. Edwards, Functional Analysis, Holt Rinehart and Winston, New York, 1965.
17. C. Goffman and G. Pedrick, First Course in Functional Analysis, Prentice Hall of India, New Delhi, 1987.
18. P. K. Jain, O.P. Ahuja and Khalil Ahmad, Functional Analysis, New Age International (P) Ltd. & Wiley Eastern Ltd., New Delhi, 1997.
19. R. B. Holmes, Geometric Functional Analysis and its Applications, Springer-Verlag, 1975.
20. K.K. Jha, Functional Analysis, Students' Friends, 1986.
21. L. V. Kantorovich and G.P. Akilov, Functional Analysis, Pergamon Press, 1982.
22. E. Kreyszig, Introductory Functional Analysis with Applications, John Wiley & Sons, New York, 1978.
23. B. K. Lahiri, Elements of Functional Analysis, The World Press Pvt. Ltd., Calcutta, 1994.
24. A. H. Siddiqui, Functional Analysis with Applications, Tata McGraw-Hill Publishing Company Ltd. New Delhi


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25. B. V. Limaye, Functional Analysis, Wiley Eastern Ltd.
26. L. A. Lustenik and V.J. Sobolev, Elements of Functional Analysis, Hindustan Publishing Corporation, New Delhi, 1971.
27. G. F. Simmons, Introduction to Topology and Modern Analysis, McGraw-Hill Book Company, New York, 1963.
28. A. E. Taylor, Introduction to Functional Analysis, John Wiley and Sons, New York, 1958.
29. K. Yosida, Functional Analysis, 3'" edition Springer-Verlag, New York, 1971.
30. J. B. Conway, A Course in Functional Analysis, Springer-Verlag, New York, 1990.
31. Walter Rudin, Functional Analysis, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 1973.
32. A. Wilansky, Functional Analysis, Blaisdell Publishing Co., 1964.
33. J. Tinsley Oden & Leszek F. Dernkowicz, Applied Functional Analysis, CRC Press Inc., 1996.

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# M.Sc. /M.A. Course (Third Semester)

## PAPER -II (Code - 211302)

## Partial Differential Equations

Max. Marks 80

## Partial Differential Equations

**Unit-I** Examples of PDE. Classification. Transport Equation-Initial value Problem. Non-homogeneous Equation, Laplace's Equation- Fundamental Solution, Mean Value Formulas, Properties of Harmonic Functions, Green's Function, Energy Methods.

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

**Unit-III** Non-linear First Order PDE-Complete Integrals, Envelopes, Characteristics, Hamilton Jacobi Equations (Calculus of Variations, Hamilton's ODE, Legendre Transform, Hopf-Lax Formula, Weak Solutions, Uniqueness), Conservation Laws (Shocks, Entropy Condition, Lax Oleinik formula, Weak Solutions, Uniqueness, Riemann's Problem, Long Time Behaviour)

**Unit-IV** Representation of Solutions-Separation of Variables, Similarity Solutions (Plane and Travelling Waves, Solitons, Similarity under Scaling), Fourier and Laplace Transform, Hopf-Cole Transform, Hodograph and Legendre Transforms, Potential Functions.

**Unit- V** Asymptotic (Singular Perturbations, Laplace's Method, Geometric Optics, Stationary Phase, Homogenization), Power Series (Non- characteristic Surfaces, Real Analytic Functions, Cauchy- Kovalevskaya Theorem).

## Books Recommended:

1. L. C. Evans, Partial Differential Equations, Graduate Studies in Mathematics, Volume 19, AMS, 1998.

## References

1. Books on Partial differential equation by 1.N. Sneddon, F. John, P. Prasad and R. Ravindran, Amarnath etc.

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# M.Sc. /M.A. Course (Third Semester)

## PAPER-III (A) (Code - 211311)

## Fundamentals of Computer Science-Theory and Practical (Object Oriented Programming and Data Structure)

Max. Marks. 100 (Theory-70 +Practical-30)

**Unit-I** Object Oriented Programming-Classes and Scope, nested classes, pointer class members; Class initialization, assignment and destruction.

**Unit-II** Overloaded functions and operators; Templates including class templates; class inheritance and virtual functions.

**Unit-III** Data Structures-Analysis of algorithms, q, W, 0, o, w notations; Sequential and linked representations, Lists, Stacks, and queues;

**Unit-IV** Trees: Binary tree- search tree implementation, B-tree (concept only);

**Unit-V** Sorting: Insertion sort, shell sort, quick-sort, heap sort and their analysis; Hashing-open and closed.

## Books Recommended:


1. S. B. Lipman, J. Lajoi: C++ Primer, Addison Wesley.
2. B. Stroustrup; The C++ Programming Language, Addison Wesley.
3. C. J. Date : Introduction to Database Systems, Addison Wesley.
4. C. Ritehie: Operating Systems-Incorporating UNIX and Windows, BPB Publications.
5. M. A. Weiss, Data Structures and Algorithm Analysis in C++, Addison Wesley.


**Practical Examination Scheme**

| | |
|---|---|
| Max. Marks – 30 | Time Duration – 3 Hrs. |
| Practical (two) | 20 Marks (10 marks each) |
| Viva | 05 Marks |
| Sessional | 05 Marks |

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## "Details of Practical Work"
## Section-A

CPP PROGRAM

1. Write a program that perform push, pop and display operations into stack.
2. Write a program that perform insert, delete and display operations into queue.
3. Write a program that convert any expression into reverse polish notation.
4. Write a program that perform addition, subtraction and Transpose operations into Matrix.
5. Write a program that performs addition of sparse matrix.
6. Write a program that perform sorting of link list.
7. Write a program for creating Binary search tree and perform lnorder, Preorder and postorder traversing operation.
8. Write a program for reverse of link list
9. Design a template for sorting different data type.
10. Write a program for selection sort.
11. Write a program for merging.
12. Write a program for insertion sort.
13. Write a program for bubble sort.
14. Write a program for Merge sort.
15. Write a program for quick sort.
16. Write a program for Heep sort.

## Section-B

OPERATING SYSTEM COMMANDS –

1. Use various option of Is Commands
2. Use the commands pwd, cd, rmdir, mkdir and mv commands.
3. Use command chmode.
4. Write a shell script for display fabonacci series of number
5. Write a shell script of find out factorial of given no.
6. Write a shell script for checking palindrome.

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RDBMS Assignment -

1. Create the following table

i) Employee (fname varchar) (15), Iname varchar (15), ssn Char (9), Bdate, Address Varchar (20), sex char, salary Decimal (10,2), superssn char (9), Dno int).

ii) Department (Dname varchar (15), Dnumber int, Mrgssn Char (9), Mgrstardate date)

iii) Project (Pnumber int, pName Varchar (15), Plocation varchar (15), Dnum Int)

iv) Works_on (essn char (9), Pho integer, Howrs decinal (4,1) Dependent [Essn Chov (9), Dependent-name varchar (15), sex char, Bdata date, Relationship varchar (8)]

2. Alter table employee and add one field job varchar (12).
3. Use insert command to insert data in above table.
4. Retrieve the Birthdata and address of employee whose name is John B. Smith.
5. Retrieve the name and address of all employee whow works for the 'Research' Department.
6. Write the name of employees whose address in University Campus (like function).
7. Find all the employees who were born during the 1950s.
8. Write the name of employees whose salary is between 10,000 to 20,000.
9. Retrieve the name of each employee who has a dependent with the same first name and same sex as the employee.
10. Retrieve the name of employee who have no dependent.
11. Find the sum of the salaries of all employees, the maximum salary and the minimum salary.
12. Find the sum of the salaries of all employees of the 'Research' department as well the maximum and minimum salary.
13. Retrieve the department number the no. of employee in each department and their aggregate salary.
14. Write query to delete all the employee whose name start with the character 'a'.
15. Use command commit rollback.

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## M.Sc. /M.A. Course (Third Semester)

### PAPER-III (B) (Code - 211312)

### General Relativity & Cosmology (I)

Max Marks – 80

**Unit-I** General Relativity-Transformation of coordinates. Tensors. Algebra of Tensors. Symmetric and skew symmetric Tensors. Contraction of tensors and quotient law. Reimannian metric. Parallel transport. Christoffel Symbols. Covarient derivatives, intrinsic derivatives and geodesies.

**Unit-II** Riemann Christoffel curvature tensor and its symmetry properties. Bianchi identities and Einstein tensor. Review of the special theory of relativity and the Newtonian Theory of gravitation.

**Unit-III** Principle of equivalence and general covariance, geodesic principle, Newtonian approximation of relativistic equations of motion. Einstein's field equations and its Newtonian approximation.

**Unit-IV** Schwarzschild external solution and its isotropic form. Planetary orbits and anologues of Kepler's Laws in general relativity. Advance of perihelion of a planet. Bending of light rays in a gravitational field, vitational redshift of spectral lines. Radar echo delay.

**Unit-V** Energy-momentum tensor of a perfect fluid. Schwarzschild internal solution. Boundary conditions. Energy momentum tensor of an electromagnetic field. Einstein-Maxwell equations. Reissner-Nordstrfim solution.

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## REFERENCES:


1. C. E. Weatherbum, An Introduction to Riemannian Geometry and the lensor Calculus, Cambridge University Press, 1950.
2. H. Stepheni, General Relativity: An Introduction to the theory of the gravitational field, Cambridge University Press, 1982.
3. A. S. Eddinglon, The Mathematical Theory of Relativity, Cambridge University Press, 1965.
4. J. V. Narlikar, General Relativity and Cosmology, The Macmillan Company of India Limited, 1978.
5. R. Adiev, M. Bazin, M. Schiffer, Introduction to general relativity, McGraw Hill Inc., 1975.
6. B. F. Shutz, A first course in general relativity, Cambridge University Press,1990.
7. S. Weinberg, Gravitation and Cosmology: Principles and applications of the general theory of relativity, John Wiley & Sons, Inc. 1972.
8. R. K. Sachs and H. Wu., General Relativity for Mathematician, Springer Verlag, 1977.
9. J. L. Synge, Relativity: The general theory. North Holland Publishing Company, 1976.


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## M.Sc. /M.A. Course (Third Semester)
### PAPER-III (C) (Code - 211313)
### Fuzzy Set Theory and Its Applications (I)

Max Marks – 80

**UNIT-I** Fuzzy sets-Basic definitions, $\alpha$-level sets. Convex fuzzy sets. Basic operations on fuzzy sets. Types of fuzzy sets. Cartesian products, Algebraic products. Bounded sum and difference, t-norms and t-conorms.

**UNIT-II** The Extension Principle- The Zadeh's extension principle. Image and inverse image of fuzzy sets. Fuzzy numbers. Elements of fuzzy arithmetic.

**UNIT-III** Fuzzy Relations on Fuzzy sets, Composition of Fuzzy relations. Min-Max composition and its properties.

**UNIT-IV** Fuzzy equivalence relations. Fuzzy compatibility relations. Fuzzy relation equations. Fuzzy graphs, Similarity relation.

**UNIT-V** Possibility Theory-Fuzzy measures. Evidence theory. Necessity measure. Possibility measure. Possibility distribution. Possibility theory and fuzzy sets. Possibility theory versus probability theory.

**REFERENCES :**


1. H. J. Zmmemann, Fuzzy set theory and its Applications, Allied Publishers Ltd. New Delhi, 1991.
2. G. J. Klir and B. Yuan- Fuzzy sets and fuzzy logic, Prentice-Hall ol India, New Delhi, 1995.


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# M.Sc./M.A. Course (Third Semester)

## PAPER-III (D) (Code - 211314)

## Mathematical Biology (I)

Max. Marks - 80

**UNIT-I**

**Population Dynamics**

Malthusian growth model, Logistic equation, model of species competition, Linear and Nonlinear First Order Discrete Time Models, Biology of Insect Population Dynamics, Model for Insect Population Dynamics with Competition, Differential Equation Models.

**UNIT-II**

**Age Structured Population Dynamics**

Evolutionary Aspects, Harvesting and Fisheries, Metapopulations, Delay Effects, Fibonacci's Rabbits, golden ratio, Age-structured Population's in Discrete Time, continuous age-structured populations, Euler-Lotka Equations.

**UNIT-III**

**Population Dynamics of Interacting Species**

Host-parasitoid Interactions, Lotka-Volterra Prey-predator Equations, Modelling the Predator Functional Response, Ecosystems Modelling, Interacting Metapopulations, Competition, Predation, Predator-mediated Coexistence of Competitors, Effects of Habitat Destruction.

**UNIT-IV**

**Population Genetics and Evolution**

Mendelian Genetics in Populations with Non-overlapping Generations, Haploid genetics, Spread of a favored allele, Mutation-selection balance, Diploid genetics, Sexual reproduction, Spread of a favored allele, Mutation-selection balance, Heterosis, Frequency-dependent selection, Linkage equilibrium, Random genetic drift, Evolution of the Genetic System.

**UNIT-V**

**Infectious Disease**

Simple Epidemic and SIS Diseases, SIR Epidemics, SIR epidemic disease model, SIR Endemics, SIR endemic disease model, No Disease-related Death, Including Disease- related Death, Vaccination, Evolution of virulence, Vector -borne Diseases, Basic Model for Macroparasitic Diseases.

**Recommended Books**


1. Jeffrey R. Chasnov, Mathematical Biology, Lecture Notes for MATH(365), The Hong Kong University of Science and Technology (2010)
2. Nicholas F. Britton, Essential Mathematical Biology, Springer-Verlag(2003)
3. J.D.Murray, Mathematical Biology I. An Introduction, Springer-Verlag (2002) 3rd Edition.
4. J. D. Murray, Mathematical Biology II. Spatial Models and Biomedical Application, Springer-Verlag (2003) 3rd Edition.


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# M.Sc./M.A. Course (Third Semester)
## PAPER –IV (A) (Code - 211321)
## Operations Research (I)

Max. Marks 80

**Unit-I** Operations Research and its Scope. Necessity of Operations Research in Industry. Linear Programming-Simplex Method. Theory of the Simplex Method. Duality and Sensitivity Analysis.

**Unit-II** Other Algorithms for Linear Programmrng-Dual Simplex Method.

**Unit-III** Parametric Linear Programming. Upper Bound Technique. Interior Point Algorithm. Linear Goal Programming.

**Unit-IV** Transportation and Assignment Problems.

**Unit-V** Network Analysis-Shortest Path Problem. Minimum Spanning Tree Probiem. Maximum Flow I Problem. Minimum Cost Flow Problem. Network Simplex Method. Project Planning and Control I with PERT-CPM.

## Books Recommended :


1. F. S. Hillier and G.J. Ueberman. Introduction to Operations ResBareft (Sixth Edition), McGraw Hill International Edition, Industrial Engineering Series, 1995. (This book comes with a CD containing tutorial software).
2. G. Hadley, Linear Programming, Narosa Publishing House, 1995.
3. G. Hadly, Nonlinear and Dynamic Programming, Addison-Wesley, Reading Mass.
4. H. A. Taha, Operations Research -An introduction, Macmillan Publishing Co., Inc., New Yark.
5. Kanti Swarup, P.K. Gupta and Man Mohan, Operations Research, Sultan Chand & Sons, New Delhi
6. Mokhtar S. Bazaraa, John J. Jarvis and Hanif D. Sherali, Linear Programming and Network flows, John Wiley & Sons, New York, 1990.


## References


1. S. S. Rao, Optimization Theory and Applications, Wiley Eastern Ltd., New Delhi.
2. Prem Kumar Gupla and D.S. Hira, Operations Research-An Introduction. S. Cliand & Company Ltd., New Delhi.
3. N. S. Kambo, Mathematical Programming Techniques, Affiliated East-West Press Pvt. Ltd., New Delhi, Madras
4. R. K. Rathy, An Introduction to Fluid Dynamics, Oxford and IBH Publishing Company, New Delhi, 1976.
5. A. D. Young, Boundary Layers, AIAA Education Series, Washington DC, 1989.
6. S. W. Yuan, Foundations of Fluid Mechanics, Prentice Hall of India Private


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Limited, New Delhi, 1976.

7. LINGO Systems Products (Visit websHe htlp://www.Hndo.com/productsf.html)
   (i) LINGO (the linear programming solver)
   (ii) LINGO Callable Library (the premier optimisation engine)
   (iii) LINGO (the linear, non-linear, and integer programming solver with mathematical modelling language)
   (i) What's Best I (the spreadssheet add-in that solves linear, non- linear, and integer problems).

   All the above four products are bundled into one package to form the Solver Suite. For more details about any of the four products one has to click on its name.
   (i) Optimisation Modelling with LINGO (8" edition) by Linus Schrage.
   (ii) Optimisation Modelling with LINGO by Unus Schrage.
   More details available on the Related Book page York, 1979.

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## M.Sc./M.A. Course (Third Semester)
### PAPER-IV (B) (Code - 211322)
### Wavelets (I)

Max Marks – 80

**Unit-I.** Preliminaries-Different ways of constructing wavelets- Orthonormal bases generated by a single function: the Balian-Low theorem. Smooth projections on $L^2(R)$.

**Unit-II.** Local sine and cosine bases and the construction of some wavelets. The unitary folding operators and the smooth projections.

**Unit-III.** Multiresolution analysis and construction of wavelets. Construction of compactly supported wavelets and estimates for its smoothness. Band limited wavelets.

**Unit-IV.** Orthonormality. Completeness. Characterization of Lemarie-Meyer wavelets and some other characterizations. Franklin wavelets and Spline wavelets on the real line.

**Unit-V.** Orthonormal bases of piecewise linear continuous functions for $L^2(T)$. Orthonormal bases of periodic splines. Periodization of wavelets defined on the real line.

**REFERENCES:**


1. Eugenic HernBndez and Guido Weiss, A First Course on Wavelets, CRC Press, New York, 1996.
2. C. K. Chui, An Introduction to Wavelets, Academic Press, 1992.
3. I. Daubechies, Ten Lectures on Wavelets, CBS-NSF Regional Conferences in Applied Mathematics, 61, SIAM, I 1992.
4. Y. Meyer,Wavelets, algorithms and applications (Tran.by R.D. Rayan,SIAM, 1993.
5. M. V. Wickerhauser, Adapted wavelet analysis from theory to software, Wellesley, MA, A.K. Peters, 1994.


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# M.Sc. /M.A. Course (Third Semester)

## PAPER –V (A) (Code - 211331)

## Programming in C (with ANSI features) Theory and Practical (I)

Max. Marks. 100

(Theory-70 +Practical-30)

**Unit-I** An overview of programming. Programming language, Classification. C Essentials-Program Development. Functions. Anatomy of a C Function. Variables and Constants. Expressions. Assignment Statements. Formatting Source Files. Continuation Character. The Preprocessor.

**Unit-II** Scalar Data Types-Declarations, Different Types of Integers. Different kinds of Integer Constants. Floating-Point Types. Initialization. Mixing Types. Explicit Conversions-Casts. Enumeration Types. The Void Data Type. Typedefs. Finding the Address of an object. Pointers.

**Unit-III** Control Flow-Conditional Branching. The Switch Statement. Looping. Nested Loops. The break and continue Statements. The goto statement. Infinite Loops.

**Unit-IV** 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 Operator. Size of Operators. Conditional Operator. Memory Operators.

**Unit-V** Arrays -Declaring an Array. Arrays and Memory. Initializing Arrays. Encryption and Decryption.

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## Books Recommended :


1. Peter A. Darnell and Philip E. Margolis, C: A Software Engineering Approach, Narosa Publishing House (Springer International Student Edition) 1993.
2. Samuel P. Harkison and Gly L. Steele Jr., C : A Reference Manual, 2nd Edition, Prentice Hall, 1984.
3. Brian W. Kernighan & Dennis M. Ritchie, The C Programme Language, 2nd Edition (ANSI Features), Prentice Hall 1989.


**Practical Examination Scheme**

| | |
|---|---|
| Max. Marks – 30 | Time Duration – 3 Hrs. |
| Practical (two) | 20 Marks ( 10 marks each) |
| Viva | 05 Marks |
| Sessional | 05 Marks |

**"Details of Practical Work"**

1. Write a program for creating marksheet & providing them grade.
2. Write a program for marking Pyramid of numbers.
3. Write a program for Calculating average & standard deviation.
4. Write a program for finding sum of series (Sin, Cos, Tan).
5. Write a program for finding LCM of given numbers.
6. Write a program for numerical solution of algebraic equation using Newton Raphson method.
7. Write a program for numerical integration of function applying Simpson one-third rule.
8. Write a program for sorting and strings using selection or insertion sorting technique.
9. Write a program to find product of two Matrix of any given order.
10. Write a program for finding inverse of Matrix of any order.
11. Write a program for to create the string functions "sullen", "strcpy".
12. Write a program for writing & reading data from Text file.
13. Write a program for copy one file to another using command line argument.
14. Write a program for creating & storing of book record using following structure-

    a. Book Acc No  b. Name  c. Title
    d. Author  e. Publication  f. Date of Publishing.
15. Write a program for searching a particular book from book record, sorting of book record on the basis of accno or name.
16. Write a program for applying appending, deleting & modification of book record.
17. Write a program for solving congruence equations using Chinese remainder theorem.
18. Write a program for finding GCD of given integers using Euclid algorithm.
19. Write a program for find initial basic feasible solution of the

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transportation problem using Vogel's Approximation Method.

20. Write a program for sequencing problem processing jobs through k machines using Optimal sequence Algorithm.
21. Write a program for finding shortest path of a network using Dijkstra's algorithm.
22. Write a program for finding minimum spanning tree of a network problem using Kruskal's algorithm.
23. Write a program for find maximum flow through a network using MFP Algorithm.

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## M.Sc./M.A. Course (Third Semester)
### PAPER-V (B) (Code - 211332)
### Graph theory (I)

Max. Marks - 80

Unit-I: Operations on graphs, matrices and vector spaces: Topological operations, Homeomerphism, homomorphism, contractions, derived graphs, Binary operations.

Unit-II: Matrices and vector spaces: Matrices and vector spaces: The adjacency matrix, The determinant and the spectrum, Spectrum properties, The incidence matrix, cycle space and Bond space, Cycle bases and cycle graphs.

Unit-III: Colouring packing and covering: Vertex coverings, critical graphs, Girth and chromatic number, uniquely colourable graphs, edge-colourings, Face colourings and Beyond, The achromatic and the Adjoint Numbers.

Unit-IV: Combinational formulations: Setting up of combinational formulations, the classic pair of duals, Gallai, Norman-Rabin Theorems, Clique parameters, The Rosenfeld Numbers.

Unit-V: Perfect Graphs: Introduction to the "SPGC", Triangulated (Chordal) graphs, Comparability graphs, Interval graphs, permutation graphs, circular arc graphs, split graphs, weakly triangulated graphs.

**REFERENCES :**


1. K. R. Parthasarathy, Basic graph theory, Tata Mc graw Hill publishing company limited , 1994.
2. R. J. Wilson, Introduction to graph theory, Longman Harlow, 1985.
3. John Clark, Derek Allon Holton, A first look at graph Theory, World Scientific Singapore, 1991.
4. Frank Hararary, Graph Theory Narosa, New Delhi, 1995.
5. Ronald Gould and Benjamin Cummins, Graph Theory, California.
6. Narsingh Deo, Graph Theory with applications to Engineering and Computer Science, Prentice-Hall of India Private Limited, New Delhi, 2002.


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# M.Sc./M.A. Course (Third Semester)

## PAPER-V (C) (Code - 211333)

## Algebraic Number Theory (I)

Max Marks – 80

**UNIT-I**

**Elementary Number Theory:** Primes and factorization, Division Algorithm, Congruence, Congruence and Modular Arithmetic, Euler phi function, Primitive roots of Unity, Quadratic law of Reciprocity, Arithmetical functions, Mobius Inversion Formula, The Diophantine Equations, Farey Sequences.

**UNIT-II**

**Algebraic Numbers:** Algebraic Numbers, Conjugates and Discriminants, Algebraic Integers, Integral Bases, Rings of Integers.

**UNIT-III**

**Special Fields:** Calculations for Quadratic fields, cubic fields, biquadratic fields and sextic fields.

**UNIT-IV**

**Localization:** Localization, Integral closure, Prime ideals, Chinese remainder theorem, Galois extensions. **Rings:** Dedekind rings, discrete valuation rings, Explicit factorization of a prime.

**UNIT-V**

**Completions:** Definitions and completions, Polynomials in complete fields, Structure of complete discrete valuation ring, extension of complete fields.

**References:**


1. Serge Lange: Algebraic Number Theory, Springer-Verlag, 1986.
2. Jean-Pierre Serre: Local Fields, Springer-Verlag, 1979
3. M. Ram Murty, Jody Esmonde: Problems in Algebraic Number Theory (2nd ed.), Springer, 2005.
4. H. P. F. Swinnerton-Dyer: A Brief Guide to Algebraic Number Theory, Cambridge University Press, 2001
5. A. Frohlich , M.J. Taylor: Algebraic Number Theory, Cambridge University Press, 1991.
6. Ian Stewart, David Tall : Algebraic Number Theory and Fermat's Last Theorem (3rd ed.), A K Peters, Natick, Massachusetts, 2002.
7. Ethan D. Bolker: Elementary Number Theory, An Algebraic Approach, W. A. Benjamin, Inc., New York, 1970
8. Jurgen Neukirch: Algebraic Number Theory, Springer-Verlag, 1999
9. William Stein: Algebraic Number Theory, a Computational Approach, Cambridge University Press, 1991.
10. G. A. Jones and J. M. Jones, Elementary Number Theory, Springer, 1998.


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# HEMCHAND YADAV VISHWAVIDYALAYA, DURG (C.G.)

**Scheme of Examination**
**M.A. /M.Sc. (MATHEMATICS)**
**(Semester-IV) (Code - 212)**
**2024-25 & Onward**

There shall be five papers. Two compulsory and three optional papers. Each paper shall have 100 marks. The paper which has theory and practical both, the theory part shall have 70 marks and practical part shall have 30 marks. **Overall tally of marks in theory and practical will be 500.**

| Paper | | Des crip | Theory | Sessional | Practical | Rem ark | Credit |
|---|---|---|---|---|---|---|---|
| **Compulsory Papers** | | | | | | | |
| I | | Functional Analysis (II) | 80 | 20 | -- | -- | 05 |
| II | | Mechanics | 80 | 20 | -- | -- | 05 |
| **Optional Papers** | | | | | | | |
| III | A | Operating System and Database Management System<br>Maths Lab-III | 70 | -- | 30 | For regular students only | 03<br>02 |
| | B | Cosmology (II) | 80 | 20 | -- | -- | 05 |
| | C | Fuzzy Set Theory & Its Applications (II) | 80 | 20 | -- | -- | 05 |
| | D | Mathematical Biology(II) | 80 | 20 | -- | -- | 05 |
| IV | A | Operations Research (II) | 80 | 20 | -- | -- | 05 |
| | B | Wavelets (II) | 80 | 20 | -- | -- | 05 |
| V | A | Programming in C (with ANSI Features) (II)<br>Maths Lab-IV | 70 | -- | 30 | For regular students | 03<br>02 |
| | B | Graph Theory (II) | 80 | 20 | -- | | 05 |
| | C | Algebraic Number | 80 | 20 | -- | | 05 |

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# HEMCHAND YADAV VISHWAVIDYALAYA, DURG (C.G.)

## M.Sc. /M.A. Course (Fourth Semester)

### PAPER -I (Code - 212401)

### Functional Analysis (II)

Max. Marks 80

**Unit-I** Uniform boundedness theorem and some its consequences. Open mapping and closed graph theorems.

**Unit-II** Hahn-Banach theorem for real linear spaces, complex linear spaces and normed linear spaces. Reflexive spaces. Weak Sequential Compactness. Compact Operators. Solvability of linear equations in Banach spaces. The closed Range Theorem.

**Unit-III** Inner product spaces. Hilbert spaces. Orthonormal Sets. Bessel's inequality. Complete orthonormal sets and Parseval's identity.

**Unit-IV** Structure of Hilbert spaces. Projection theorem. Riesz representation theorem. Adjoint of an operator on a Hilbert space. Reflexivity of Hilbert spaces.

**Unit-V** Self-adjoint operators, Positive, projection, normal and unitary operators. Abstract variational boundary-value problem. The generalized Lax-Milgram theorem.

## Books Recommended :


1. B. Choudhary and S. Nanda, Functional Analysis with Applications. Wiley Eastern Ltd. 1989.


## References


1. Serge Lang, Analysis I & II, Addison-Wesley Publishing Company, Inc. 1967.
2. Walter Rudin, Real & Complex Analysis, Tata McGraw-Hill Publishing.
3. Edwin Hewitt and Korl Stromberg, Real and Abstract Analysis, Springer-Verlag, New York.
4. Edwin Hewitt and Kenneth A. Ross, Abstract Harmonic Analysis, Vol. 1, Springer-Verlag, 1993.


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5. G. Bachman and L. Narici, Functional Analysis, Academic Press, 1966.
6. N. Dunford and J.T. Schwartz, Linear Operators, Part I, Interscience, New York, 1958.
7. R. E. Edwards, Functional Analysis, Holt Rinehart and Winston, New York, 1965.
8. C. Goffman and G. Pedrick, First Course in Functional Analysis, Prentice Hall of India, New Delhi, 1987.
9. P. K. Jain, O.P. Ahuja and Khalil Ahmad, Functional Analysis, New Age International (P) Ltd. & Wiley Eastern Ltd., New Delhi, 1997.
10. R. B. Holmes, Geometric Functional Analysis and its Applications, Springer-Verlag, 1975.
11. K. K. Jha, Functional Analysis, Students' Friends, 1986.
12. L. V. Kantorovich and G.P. Akilov, Functional Analysis, Pergamon Press, 1982.
13. E. Kreyszig, Introductory Functional Analysis with Applications, John Wiley & Sons, New York, 1978.
14. B. K. Lahiri, Elements of Functional Analysis, The World Press Pvt. Ltd., Calcutta, 1994.
15. A. H. Siddiqui, Functional Analysis with Applications, Tata McGraw-Hill Publishing Company Ltd. New Delhi
16. B.V. Limaye, Functional Analysis, Wiley Eastern Ltd.
17. L.A. Lustenik and V.J. Sobolev, Elements of Functional Analysis, Hindustan Publishing Corporation, New Delhi, 1971.
18. G. F. Simmons, Introduction to Topology and Modern Analysis, McGraw-Hill Book Company, New York, 1963.
19. A. E. Taylor, Introduction to Functional Analysis, John Wiley and Sons, New York, 1958.
20. K.Yosida, Functional Analysis, 3'" edition Springer-Verlag, New York, 1971.
21. J.B. Conway, A Course in Functional Analysis, Springer-Verlag, New York, 1990.
22. Walter Rudin, Functional Analysis, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 1973.
23. A. Wilansky, Functional Analysis, Blaisdell Publishing Co., 1964.
24. J. Tinsley Oden & Leszek F. Demkowicz, Applied Functional Analysis, CRC Press Inc., 1996.

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# M.Sc./M.A. Course (Fourth Semester)

## PAPER -II (Code - 212402)

## Mechanics

**Max. Marks 80**

## Analytical Dynamics:

**Unit-I** Generalized coordinates. Holonomic and Non-holonomic systems. Scleronomic and Rheonomic sytems. Generalized potential. Lagrange's equations of first kind. Lagrange's equations of second kind. Uniqueness of solution. Energy equation for conservative fields. Hamilton's variables. Donkin's theorem. Hamilton canonical equations. Cyclic coordinates. Routh's equations.

**Unit-II** Poisson's Bracket. Poisson's Identity. Jacobi-Poisson Theorem. Motivating problems of calculus of variations, shortest distance. Minimum surface of revolution. Brachistochrone problem. Isoperimetric problem. Geodesic. 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. Conditional extremum under geometric constraints and under integral constraints.

**Unit-III** Hamilton's Principle. Principle of least action. Poincare Cartan Integral invariant. Whittaker's equations. Jacobi's equations. Lee Hwa Chung's theorem, canonical transformations and properties of generating functions.

**Unit-IV** Hamilton-Jacobi equation. Jacobi theorem. Method of separation of variables. 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.

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## Gravitation:

**Unit-V** Attraction and potential of rod, disc, spherical shells and sphere. Surface integral of normal attraction (Application & Gauss' theorem). Laplace and Poisson equations.

Work done by self-attracting systems. Distributions for a given potential. Equipotential surfaces. Surface and solid harmonics. Surface density in terms of surface harmonics.

## Books Recommended:


1. F. Gantmacher, Lectures in Analytic Mechanics, MIR Publishers, Moscow, 1975.
2. R. C. Mondal, Classical Mechanics, Prentice Hall of India
3. M.M Rahman, Attraction and Potential Atlantic Publishers and Distributer Pvt. Ltd.
4. R.N. Tiwari & B.S. Thakur Classical Mechanics, PHI.


## References


1. A. S. Ramsey, Dynamics Part II, The English Language Book Society and Cambridge University Press, 1972.
2. H. Goldstein, Classical Mechanics (2nd edition), Narosa Publishing House, New Delhi.
3. I. M. Gelfand and S.V. Fomin, Calculus of Variations, Prentice Hall.
4. Narayan Chandra Rana & Pramod Sharad Chandra Joag, Classical Mechanics, Tata McGraw Hill, 1991.
5. Louis N. Hand and Janet D. Finch, Analytical Mechanics, Cambridge University Press, 1998.


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# M.Sc./M.A. Course (Fourth Semester)
## PAPER-III (A) (Code - 212411)
## Operating System and Database Management System - Theory and Practical

Max. Marks. 100

(Theory-70 +Practical-30)

**Unit-I** Database Systems-Role of database systems, database system architecture and data modeling.

**Unit-II** Introduction to relational algebra and relational calculus.

**Unit-III** Introduction to SQL: Basic features including views; Integrity constraints; Database design-normalization up to BCNF.

**Unit-IV** Operating Systems- Overview of operating system, user interface, processor management, memory management.

**Unit-V** I/O management, concurrency and Security, network and distributed systems.

## Books Recommended :


1. S. B. Lipman, J. Lajoi: C++ Primer, Addison Wesley.
2. B. Stroustrup; The C++ Programming Language, Addison Wesley.
3. C. J. Date : Introduction to Database Systems, Addison Wesley.
4. C. Ritehie: Operating Systems-Incorporating UNIX and Windows, BPB Publications.
5. M. A. Weiss, Data Structures and Algorithm Analysis in C++, Addison Wesley.


**Practical Examination Scheme**

| | |
|---|---|
| Max. Marks – 30 | Time Duration – 3 Hrs. |
| Practical (two) | 20 Marks (10 marks each) |
| Viva | 05 Marks |
| Sessional | 05 Marks |

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**M.sc. Mathematics (IV$^{th}$ Sem.)**
**Practical List (Paper – III)**
**Operation System and Database Management System**

1. Create table for the following:
   i. Client master
   ii. Product master
   iii. Salesman master
2. Insert values into the following :
   i. Client master
   iv. Product master
   v. Salesman master

3. Find out the names of all the client and retrieve the entire contents of the client master table.
4. Retrieve the list of names, city and the state of all the clients.
5. List the various product available from the product master table.
6. List all the clients who are located in Mumbai.
7. Find the names of salesman who have a salary equal to Rs. 3000.
8. Change the city of clientno 'C000S' to Banglore.
9. Change the Baldue of clientno 'C0001' to Rs. 1000.
10. Change the City of salesman to pune.
11. Delete all the salesman from the sales master whose salaried are equal to Rs. 3500.
12. Delete all the products from the product master where the quality on hand is equal to 100.
13. Add a column called ' Telephone' of data type number & size = 10 to the client master table.
14. Change the size of sellprice column in product master to 10,2.
15. Destroy the table client master along with is data.
16. List the names of all clients having 'a' as the second letter in their names.
17. Calculate the average price of all the products.
18. Determine the Maximum and minimum product prices.
19. Count the number of product having price less than or equal to 500.
20. List all the product whose qtyonhand is less than recorder level.

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## M.Sc./M.A. Course (Fourth Semester)
### PAPER-III (B) (Code - 212412)
### Cosmology (II)

Max Marks – 80

**Unit-I**: Cosmology-physical universe, Mach's principle, Einstein modified field equations with cosmological term.

**Unit-II**: Static Cosmological models of Einstein and De-Sitter, their derivation, properties and comparison with the actual universe.

**Unit-III**: Hubble's law. Cosmological principles. Weyl's postulate. Derivation of Robertson-Walker metric. Hubble and deceleration parameters. Redshift. Redshift versus distance relation. Angular size versus redshift relation and source counts in Robertson-Walker space-time.

**Unit-IV**: Friedmann models. Fundamental equations of dynamical cosmology. Critical density. Closed and open Universes. Age of the Universe. Matter dominated era of the Universe.

**Unit-V**: Einstein-deSitter model. Particle and even horizons. Eddington-Lamaitre models with I-term. Perfect cosmological principle. Steady state cosmology.

**REFERENCES:**


1. J. V. Narlikar, General Relativity and Cosmologyi Ths Macmillan Company of India Urnited, 1978.
2. S. Weinberg, Gravitation and Cosmology: Principles and applications of the general theory of relativity, John Wiley & Sons, Inc. 1972.
3. J. V. Narlikar, Introduction to Cosmology, Cambridge University Press, 1993.
4. L. D. Landau and E.M. Lilshitz, The classical theory of Fields, Pergamon Press, 1980.


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## M.Sc./M.A. Course (Fourth Semester)
### PAPER-III (C) (Code - 212413)
### Fuzzy Set Theory & Its Applications (II)

Max Marks – 80

**Unit-I** Fuzzy Logic-An overview of classical logic, Multivalued logics, Fuzzy propositions. Fuzzy quantifiers. Linguistic variables and hedges. Inference from conditional fuzzy propositions, the compositional rule of inference.

**Unit-II** Approximate Reasoning-An overview of Fuzzy expert system. Fuzzy implications and their selection. Multiconditional approximate reasoning. The role of fuzzy relation equation.

**Unit-III** An introduction to Fuzzy Control-Fuzzy controllers. Fuzzy rule base. Fuzzy inference engine. Fuzzification.

**Unit-IV** Defuzzification and the various defuzzitication methods (the centre of area, the centre of maxima, and the mean of maxima methods).

**Unit-V** Decision Making in Fuzzy Environment-Individual decision making. Multiperson decision making. Multicriteria decision making. Multistage decision making. Fuzzy ranking methods. Fuzzy linear programming.

**REFERENCES :**


1. H. J. Zimmemann, Fuzzy set theory and its Applications, Allied Publishers Ltd. New Delhi, 1991.
2. G. J. Klir and B. Yuan- Fuzzy sets and fuzzy logic, Prentice-Hall ol India, New Delhi, 1995.


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# M.Sc./M.A. Course (Fourth Semester)
## PAPER-III (D) (Code - 212414)
## Mathematical Biology (II)

Max. Marks - 80

**UNIT-I**

**Tumor Modelling:** Phenomenological Models, Nutrients: the Diffusion-limited Stage, Moving Boundary Problems, Growth Promoters and Inhibitors, Vascularisation, Metastasis, Immune System Response.

**UNIT-II**

**Growth and Control of Brain Tumors :** Basic Mathematical Model of Glioma Growth and Invasion, Tumour Spread *In Vitro*: Parameter Estimation, Tumour Invasion in the Rat Brain, Tumour Invasion in the Human Brain, Modelling Tumour Resection in Homogeneous Tissue, Analytical Solution for Tumour Recurrence After Resection, Modelling Surgical Resection with Brain Tissue Heterogeneity, Modelling the Effect of Chemotherapy on Tumour Growth, Modelling Tumour Polyclonality and Cell Mutation.

**UNIT-III**

**Dynamics of Infectious Diseases:** Historical Aside on Epidemics, Simple Epidemic Models and Practical Applications, Modelling Venereal Diseases, Multi-Group Model for Gonorrhea and Its Control, Bovine Tuberculosis Infection in Badgers and Cattle, Modelling Control Strategies for Bovine Tuberculosis in Badgers and Cattle.

**UNIT-IV**

**Modelling of Immunodeficiency Virus:** AIDS: Modelling the Transmission Dynamics of the Human Immunodeficiency Virus (HIV), HIV: Modelling Combination Drug Therapy, Delay Model for HIV Infection with Drug Therapy, Modelling the Population Dynamics of Acquired Immunity to Parasite Infection, Age- Dependent Epidemic Model and Threshold Criterion, Simple Drug Use Epidemic Model and Threshold Analysis.

**UNIT-V**

**Geographic Spread and Control of Epidemics:** Simple Model for the Spatial Spread of an Epidemic, Spread of the Black Death in Europe, Brief History of Rabies, Spatial Spread of Rabies Among Foxes: Background and Simple Model, Three- Species (*SIR*) Model. Control Strategy Based on Wave Propagation into a Nonepidemic Region: Estimate of Width of a Rabies Barrier, Analytic Approximation for the Width of the Rabies, Effect of Fox Immunity on the Spatial Spread of Rabies.

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**Recommended Books**


1. Jeffrey R. Chasnov, Mathematical Biology, Lecture Notes for MATH(365), The Hong Kong University of Science and Technology (2010)
2. Nicholas F. Britton, Essential Mathematical Biology, Springer-Verlag(2003)
3. J. D. Murray, Mathematical Biology I. An Introduction, Springer-Verlag (2002) 3rd Edition.
4. J. D. Murray, Mathematical Biology II. Spatial Models and Biomedical Application, Springer-Verlag (2003) 3rd Edition.


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# M.Sc./M.A. Course (Fourth Semester)

## PAPER –IV (A) (Code - 212421)

## Operations Research (II)

**Max. Marks. 80**

**Unit-I** Dynamic Programming - Deterministic and Probabilistic Dynamic programming. Integer Programming- Branch and Bound Technique.

**Unit-II** Game Theory-Two-Person, Zero-Sum Games. Games with Mixed Strategies. Graphical, Solution. Solution by Linear Programming.

**Unit-III** Integer Programming-Branch and Bound Technique.

**Unit-IV** Queuing system: Deterministic Queuing system, probability distribution in Queuing, classification of Queuing models, Poission Queuing system ((M/M/I):(∞/FIFO), (M/M/I): (SIRO), (M/M/I): (N/FIFO). Inventory control: The concept of EOQ, Deterministic inventory problem with no shortages.

**Unit-V** Nonlinear Programming-One and Multi-Variable Unconstrained Optimization. Kuhn-Tucker Conditions for Constrained Optimization. Quadratic Programming.

***References:***


1. F.S. Hillier and G.J. Ueberman. Introduction to Operations Res Bareft (Sixth Edition), McGraw Hill International Edition, Industrial Engineering Series, 1995. (This book comes with a CD containing tutorial software).
2. G. Hadley, Linear Programming, Narosa Publishing House, 1995.
3. G. Hadly, Nonlinear and Dynamic Programming, Addison-Wesley, Reading Mass.
4. Mokhtar S. Bazaraa, John J. Jarvis and Hanif D. Sherali, Linear Programming and Network flows, John Wiley & Sons, New York, 1990.
5. H. A. Taha, Operations Research-An introduction, Macmillan Publishing Co., Inc., New York.
6. K. Swarup, P.K. Gupta and Man Mohan, Operations Research, S. Chand & Sons, New Delhi.


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# M.Sc. /M.A. Course (Fourth Semester)

## PAPER-IV (B) (Code - 212422)

## Wavelets (II)

Max Marks – 80

**Unit-I** Characterizations in the theory of wavelets-The basic equations and some of its applications.

**Unit-II** Characaterizations of MRA wavelets, low-pass filters and scaling functions. Non- existence of smooth wavelets in $H^2(R)$.

**Unit-III Frames** - The reconstruction formula and the Batian-Low theorem for frames. Frames from translations and dilations. Smooth frames for $H^2(R)$.

**Unit-IV Discrete** transforms and algorithms-The discrete and the fast Fourier transforms. The discrete and the fast cosine transforms.

**Unit-IV** The discrete version of the local sine and cosine bases. Decomposition and reconstruction algorithms for wavelets.

## REFERENCES:


1. Eugenic Hern Bndez and Guido Weiss, A First Course on Wavelets, CRC Press, New York, 1996.
2. C. K. Chui, An Introduction to Wavelets, Academic Press, 1992.
3. I. Daubechies, Ten Lectures on Wavelets, CBS-NSF Regional Conferences in Applied Mathematics, 61, SIAM, I 1992.
4. Y. Meyer, Wavelets, algorithms and applications (Tran. by R.D. Rayan, SIAM, 1993.
5. M. V. Wickerhauser, Adapted wavelet analysis from theory to software, Wellesley, MA, A.K. Peters, 1994.


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## M.Sc. /M.A. Course (Fourth Semester)
### PAPER –V (A) (Code - 212431)
### Programming in C (with ANSI features) (II)
### Theory and Practical

**Max. Marks. 100** (Theory-70 +Practical-30)

**Unit-I** Storage Classes-Fixed vs. Automatic Duration. Scope. Global variables. The register Specifier. ANSI rules for the syntax and Semantics of the storage-class keywords.

**Unit-II** Pointers Pointer Arithmetic. Passing Pointers as Function Arguments. Accessing Array Elements through Pointers. Passing Arrays as Function Arguments. Sorting Algorithms. Strings. Multidimensional Arrays. Arrays of Pointers. Pointers to Pointers.

**Unit-III** Functions-Passing Arguments. Declarations and Calls. Pointers to Functions. Recursion. The main Function. Complex Declarations. The C Preprocessor-Macro Substitution. Conditional Compilation. Include Facility. Line Control.

**Unit-IV** Structures and Unions-Structures. Dynamic Memory Allocation. Linked Lists. Unions, enum Declarations.

**Unit-V** Input and Output-Streams, Buffering. The <Stdio.h> Header File. Error Handling. Opening and Closing a File. Reading and Writing Data. Selecting an I/O Method. Unbuffered I/O Random Access. The standard library for Input/Output

### Books Recommended:


1. Peter A. Darnell and Philip E. Margolis, C: A Software Engineering Approach, Narosa Publishing House (Springer International Student Edition) 1993.
2. Samuel P. Harkison and Gly L. Steele Jr., C : A Reference Manual, 2nd Edition, Prentice Hall, 1984.
3. Brian W. Kernighan & Dennis M. Ritchie, The C Programme Language, 2nd Edition (ANSI Features), Prentice Hall 1989.


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**Practical Examination Scheme**

| | |
|---|---|
| Max. Marks – 30 | Time Duration – 3 Hrs. |
| Practical (two) | 20 Marks (10 marks each) |
| Viva | 05 Marks |
| Sessional | 05 Marks |

**Practical List**
**M.sc. Mathematics (IVth Sem.)**
**Programing in 'C' (paper- 5)**

1. Wap to swap numbers using pointer?
2. Wap to add four digit numbers by using variables ?
3. Wap to find the roots of a quadrate equation?
4. Wap in C which reads a 3x2 matrix and then calculate the sum of each row and store in ID array.
5. Wap in C to read matrix A (3x4) and calculate its multiplication.
6. Wap to store any 10 number in array and pass as function argument to calculate its. Sum.
7. Wap to find the sum of square of add numbers below 100.
8. Wap for sorting the 11 elements which are neither ascending nor descending order.
9. Wap to find factorial of a number using recursion.
10. Wap to find factorial of number using recursion.
11. Wap to find the square root as a Macro.
12. Wap to red matrix of size MxN from the keyboard and display the same on the screen using function.
13. Wap to delete a node in single link list using pointer.
14. Wap to traversing in Circular link list using pointer.
15. Wap using function for DMA.
16. Wap for creating a link of a set integer numbers.
17. Wap to read and write operation in Random Access File.
18. Wap to create a file 'data' containing a series of integers and all even numbers present in the file.
19. Wap to explain opening nd closing of file.
20. Wap to generate a data file containing emp_id, emp_name and emp__telno of an institution.

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## M.Sc./M.A. Course (Fourth Semester)
### PAPER-V (B) (Code - 212432)
### Graph Theory-II

Max. Marks - 80

Unit-I: Ramsey Theory: Perpectness-preserving operations, Forbidden Subgraph orientations, Ramsey numbers and Ramsey graphs.

Unit-II: Groups: Permutation groups, The automorphism group, graphs with given group, symmetry concepts, pseudo-similarity and stability, spectral studies of the Automorphism group.

Unit-III: Polynomials and Graph Enumeration: The colour polynomials, The chromatic polynomial, The bivariate colouring polynomials.

Unit-IV: Graph Enumeration: Co-chromatic (co-dichromatic) graphs and chromatically unique graphs, Graph Enumeration.

Unit-V: Digraphs & Networks: Digraphs, Types of connectedness, Flows in Networks, Menger's and Konig's Theorem, Degree sequences.

**REFERENCES:**


1. K. R. Parthasarathy, Basic graph theory, Tata Mc graw Hill publishing company limited, 1994.
2. R. J. Wilson, Introduction to graph theory, Longman Harlow, 1985.
3. John Clark, Derek Allon Holton, A first look at graph Theory, World Scientific Singapore, 1991.
4. Frank Hararary, Graph Theory Narosa, New Delhi, 1995.
5. Ronald Gould and Benjamin Cummins, Graph Theory, California.
6. Narsingh Deo, Graph Theory with applications to Engineering and Computer Science, Prentice-Hall of India Private Limited, New Delhi, 2002.


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# M.Sc. /M.A. Course (Fourth Semester)
## PAPER-V (C) (Code - 212433)
## Algebraic Number Theory (II)

Max Marks – 80

**UNIT-I**

**Extensions:** Decomposition and ramification, Unramified extensions, Tamely ramified extensions.

**UNIT-II**

**The Different and Discriminant:** Complementary modules, The different and ramification, The discriminant.

**UNIT-III**

**Cyclotomic Fields):** Roots of unity, Quadratic fields, Gauss sums, Relations in ideal classes, Fermat's last theorem.

**UNIT-IV**

**The Structure of Units:** Dirichlet's Unit Theorem, Units in Real Quadratic Fields, Pell's equation.

**UNIT-V**

**Zeta Functions:** The Riemann Zeta Function, Dedekind Zeta Function

**References:**


1. Serge Lange: Algebraic Number Theory, Springer-Verlag, 1986.
2. Jean-Pierre Serre: Local Fields, Springer-Verlag, 1979
3. M. Ram Murty, Jody Esmonde: Problems in Algebraic Number Theory (2nd ed.), Springer, 2005.
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31/5/23 31.5.23 31-5-23