DEPARTMENT OF MATHEMATICS

COURSE CURRICULUM & MARKING SCHEME

M.Sc. MATHEMATICS

Semester - I

SESSION : 2024-25

ESTD: 1958

GOVT. V.Y.T. PG AUTONOMOUS COLLEGE, DURG, 491001 (C.G.)

(Former Name – Govt. Arts & Science College, Durg)

NAAC Accredited Grade A+, College with CPE - Phase III (UGC), STAR COLLEGE (DBT)

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DEPARTMENT OF MATHEMATICS

GOVT. V.Y.T. PG. AUTONOMOUS COLLEGE DURG (C.G.)

Approved syllabus for M.Sc. Mathematics by the members of Board of Studies for the Sessions 2024 - 25

The Syllabus with the paper combinations is as under

Semester I

I : MMT 101 - Advanced Abstract Algebra (I)	**II : MMT 102 - Real Analysis (I)**
III : MMT 103 – Topology (I)	**IV : MMT 104 - Complex Analysis (I)**
V : MMT 105 - Advanced Discrete Mathematics (I)	

The Syllabus for M.Sc. Mathematics is hereby approved for the sessions 2024 - 25

Chairperson / H.O.D - Dr. Padmavati 6/7/24

Subject Expert - Dr. Madhu Shrivastava 6-07-24

Subject Expert - Dr. Shabnam Khan

Subject Expert - Dr. S. K. Bhatt 6.7.24

Representative Members

1. Dr. Anil Kashyap -
2. Shri A. K. Pandey -
3. Dr. Mayur Puri Goswami -

Faculty members:

Dr. M.A. Siddiqui –

Dr. Rakesh Tiwari –

Dr. (Smt.) Prachi Singh –

GENERAL INSTRUCTIONS FOR STUDENTS

1. The candidate has to obtain minimum 20% marks in each theory paper and internal assessment separately.
2. The candidate has to secure minimum 36% marks as an aggregate in order to pass that semester examination.
3. The internal assessment shall include class test, home assignment and seminar presentation.
4. Internal Assessment Examination will be as follows :
   i. Internal Test in each paper (20 marks)
   ii. Seminar (Power point presentation) in any one of the paper (20 marks)
   iii. Assignment in each of the remaining papers (excluding the paper of Seminar. (20 marks)
   iv. Average of marks obtained in internal test + seminar in any one paper and marks obtained in internal test + assignment in rest of the papers will be calculated and taken into consideration.

5. There shall be one seminar in each semester. In each semester, the paper in which seminar has to be presented will be allotted randomly .The marking of seminar shall be in terms of hard copy submission (10 marks) and presentation and open discussion 10 marks. In seminar the marks taken in to consideration will be the average marks given by two examiners.

Chairperson / H.O.D - Dr. Padmavati 6/7/24 Subject Expert - Dr. Madhu Shrivastava 6-07-24 Subject Expert - Dr. Shabnam Khan Subject Expert - Dr. S. K. Bhatt **Representative Members** 4. Dr. Anil Kashyap - 5. Shri A. K. Pandey - 6. Dr. Mayur Puri Goswami -	**Faculty members:** Dr. M.A. Siddiqui – Dr. Rakesh Tiwari – Dr. (Smt.) Prachi Singh –

DIRECTIVES FOR STUDENTS, FACULTY AND EXAMINERS

Question Paper Format and Distribution of Marks for PG Semester Examination

Question paper format for the Post-Graduate Examination has been revised from the Session 2023-24. The revised format will be applicable for all the question papers of Semester I, II, III & IV. The following are the main points of the new format:

1. The question paper will be of **80 marks** (as before)
2. Questions will be asked Unit-wise in each question paper.
3. From each Unit, the questions will be asked as follows :

Very short answer type question **(Answer in one or two sentences)**	**(02 Marks)**
Very short answer type question **(Answer in one or two sentences)**	**(02 Marks)**
Short answer type question	**(04 Marks)**
Long answer type questions	**(12 Marks)**

Type of Question	Unit-I	Unit-II	Unit-III	Unit-IV
Very Short (2 Questions)	2 x 2 = 4 Marks	2 x 2 = 4 Marks	2 x 2 = 4 Marks	2 x 2 = 4 Marks
Short (1 Question)	1 x 4 = 4 Marks	1 x 4 = 4 Marks	1 x 4 = 4 Marks	1 x 4 = 4 Marks
Long answer (1 Question)	1 x 12 = 12 Marks	1 x 12 = 12 Marks	1 x 12 = 12 Marks	1 x 12 = 12 Marks

Note:

1. Question no. 1 and Question 2 will be compulsory.
2. Question no. 3 and 4 will consist of 2 optional questions of which one has to be attempted.
3. As mentioned above, two compulsory very short answer type questions (2+2 marks), one short answer type question with internal choice (4 marks) and one

long answer type question with internal choice (12 marks) will be asked from each unit.
Thus there will be questions of 20 marks from each unit and of total 80 marks from all the four units of the syllabus / syllabi

4 The students are required to study the content mentioned in the curriculum exhaustively.

CREDIT ALLOTMENTS

Theory 80 marks = 04 Credits

Internal Assessment 20 marks = 01 credit

Theory Paper + Practical = 05 credits (04+01)

Chairperson / H.O.D - Dr. Padmavati 6/7/24 Subject Expert - Dr. Madhu Shrivastava 6-07-24 Subject Expert - Dr. Shabnam Khan Subject Expert - Dr. S. K. Bhatt **Representative Members** 1. Dr. Anil Kashyap - 2. Shri A. K. Pandey - 3. Dr. Mayur Puri Goswami -	**Faculty members:** Dr. M.A. Siddiqui – Dr. Rakesh Tiwari – Dr. (Smt.) Prachi Singh –

Syllabus and Marking Scheme for M.Sc. Mathematics **First Semester** Session 2023-24.

Paper No.	Title of the Paper	Marks Allotted in Theory		Marks Allotted in Internal Assessment		Credits
		Max	Min	Max.	Min.	
I	Advanced Abstract Algebra (I)	80	16	20	04	05
II	Real Analysis (I)	80	16	20	04	05
III	Topology	80	16	20	04	05
IV	Complex Analysis (I)	80	16	20	04	05
V	Advanced Discrete Mathematics (I)	80	16	20	04	05
	Total	**400**		**100**		**25**

05 Theory papers - 400
05 Internal Assessments - 100
Total Marks - 500
Note: 20 marks = 01 credit in Theory Papers.

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3. Dr. Mayur Puri Goswami -

Faculty members:

Dr. M.A. Siddiqui –

Dr. Rakesh Tiwari –

Dr. (Smt.) Prachi Singh –

PG Department of Mathematics

Program Outcomes:

PO No.	Program outcomes upon completion of the M. Sc. Degree program, the student will be able to
PO No. - 1	Pursue higher studies in mathematics in reputed institute of our country and clear Competitive exams like SET / NET / TET etc.
PO No. – 2	Read and identify mathematical and computational methods in order to solve comprehensive problems in several competitive examinations.
PO No. – 3	Well prepared to take jobs in schools and colleges as Mathematic Teachers and Professors, Software Industries, Research and Development Organizations.
PO No.- 4	Learn and apply Mathematics in real life situations aiming at service to the society.

Program Specific Outcomes:

PSO No.	Program specific outcomes : upon completion of the M. Sc. Degree program, the student will be able to
PSO - 1	Understand the fundamental axioms in mathematics and capable to develop ideas based on them.
PSO – 2	Inculcate mathematical reasoning and develop own learning capacity.
PSO – 3	Explain the core ideas and the techniques of mathematics and developabstract mathematical thinking.
PSO - 4	Assimilate the logical approach to take decision in complicated situations.
PSO - 5	Prepare and motivate for research studies in mathematics and relatedfields.

Learning Outcomes:

After learning this course students are able to recognize and explain all about algebra.

Course Title	M. Sc. Previous, Advance Abstract Algebra
CO No.	Course Outcomes - This course will enable the student to :
CO No. – 1	Remember properties of group especially normal series and use of series in Jorden Holder Theorem.
CO No. – 2	Understand field extension with types of extension as- algebraic, transcendental, separable, inseparable and normal extension, Galois theory and solvability.
CO No.- 3	Apply module, Noetherian, Artinian modules and examples, Hilbert basis theorem and WedderzburnArtin theorem.
CO No.- 4	Analyze Linear transformation, canonical form and nilpotent transformation, understand Jorden blocks and Jorden forms, Smith normal form and rational canonical form.

Learning Outcomes:

Student able to go to deep analytic approach which is elegant proves of research.

Course Title	M. Sc. Previous, Real Analysis
CO No.	Course Outcomes - This course will enable the student to :
CO No. – 1	Remember sequences and series of functions and their convergence, various test for convergence.
CO No. – 2	Analyze Function of several variables, derivatives in open subsets, derivatives of higher order, partition of unity and Stock's Theorem.
CO No.- 3	Understand Riemman and Stieltjes integral and its properties.
CO No.- 4	Apply Idea of measures, measurable sets, Borel and Lebesgue measures.

6-07-24

6/7/24

Learning Outcomes:

Student able to go to deep concept of topological spaces which is useful in research.

Course Title	M. Sc. Previous, Topology
CO No.	Course Outcomes - This course will enable the student to :
CO No. – 1	Remember the concept of topology and algebraic topology.
CO No. – 2	Apply the concept of separation axioms, connectedness, compactness and related topics.
CO No.- 3	Understand the product topology, embedding, metrization and paracompactness.
CO No.- 4	Analyze Nets, Filters and ultra filters. Fundamental group and covering spaces.

Learning Outcomes:

Student able to go to deep concept valued function and their analytic approach in mathematics.

Course Title	M. Sc. Previous, Complex Analysis
CO No.	Course Outcomes - This course will enable the student to :
CO No. – 1	Remember the concept and consequences of analyticity and the Cauchy Riemman equations and results on harmonic and entire functions including the fundamental theorem of algebra.
CO No. – 2	Understand the application of the power series, expansion of analytic functions.
CO No.- 3	Apply Conformal mapping and bilinear transformation and their properties.
CO No.- 4	Analyze the Cauchy residue theorem to evaluate integral and sum series, analytic continuation and its properties, canonical products, Little picard theorem, Montel theorem etc.

6-07-24

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Learning Outcomes:

Student able to learn how to apply discrete mathematics in the field of engineering.

Course Title	M. Sc. Previous, Advance Discrete Mathematics
CO No.	**Course Outcomes - This course will enable the student to:**
CO No. – 1	Understand Algebraic structure, semigroups, monoids and operations on strings. Specially using in concatenation operations
CO No. – 2	Remember various types of grammars, Application of pumping lemma, Polish Notations.
CO No.- 3	Apply Finite autometa acceptors, nondeterministic finite autometa
CO No.- 4	Analyze mean terms, max terms, Boolean forms, Karnough mappings and minimization of Boolean function, cosets, Partial order relations, Lattices and its various types.

M.Sc. Mathematics (First Semester)

2024 - 2025

PAPER – I

Code- MMT 101

Advanced Abstract Algebra

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 and splitting fields.

Unit-IV Automorphism of extensions. Galois extension. Fundamental theorem of Galois Theory. 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.
3. Quazi Zameeruddin and Surjeet Singh : Modern Algebra

References:

1. M. Artin, Algeabra, 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 .
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.I-1996,Vol. II-1999)

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6. D. S.Malik, J. N. Mordeson, and M. K. Sen, Fundamentals of Abstract Algebra, Mc Graw-Hill, International Edition, 1997.
7. Vivek Sahai and Vikas Bist, Algebra, Narosa Publishing House, 1999.
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, Narosa,1982.

Chairperson / H.O.D - Dr. Padmavati	**Faculty members:**
Subject Expert - Dr. Madhu Shrivastava	Dr. M.A. Siddiqui –
Subject Expert - Dr. Shabnam Khan	Dr. Rakesh Tiwari –
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M. Sc. Mathematics (First Semester)

2024 - 2025
PAPER-II
Code- MMT 102

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. 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 variable 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 Extremum problems with constraints. Lagrange's multiplier method. Differentiation of integrals. Partitions of unity. Differential forms. Stoke's theorem.

Recommended Books:

1. Principle of Mathematical Analysis By Walter Rudin 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.
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. I, Frederick Ungar Publishing Co., 1961.

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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. Mathematics (First Semester)

2024 - 2025

PAPER-III

Code- MMT 103

Topology (I)

Max. Marks. 80

Unit-I 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. Definition and examples of topological spaces, Closed sets, Closure, Dense subsets, Neighborhoods, 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 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. Compactness. Continuous functions and compact sets. Basic properties of Compactness. Compactness and finite intersection property.

Unit-IV Sequentially and Countably compact sets. Local compactness and one point compactification. Stone-Cech compactification. 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.

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.

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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. Seymour Lipschutz, General Topology, Tata McGraw Hill Publishing Company Ltd.(Schaum's out Lines.)

Chairperson / H.O.D - Dr. Padmavati 6/7/24	**Faculty members:**
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Subject Expert - Dr. Shabnam Khan	
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M. Sc. Mathematics (First Semester)
2024 - 2025
PAPER-IV
Code- MMT 104

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. Taylor's theorem. Laurent's series.

Unit-II The zero of an analytic function. Singular and classification of singularity. Meromorphic functions. The argument principle. Rouche's theorem.The fundamental theorem of algebra. Maximum modulus principle. Schwarz lemma.Inverse function theorem. Residues. Cauchy's residue theorem. Evaluation of integrals. Branches of many valued functions with special reference to $arg\ z$, $log z$ and z^a.

Unit-III Definitions and examples of Conformal mappings. Biliner transformations- their properties and classifications. Some special bilinear transformations. The transformation of $w = z^2$, $z = \sqrt{w}$, $w = e^z$, $w = \tan^2(\pi/4a\ \sqrt{z})$

Unit-IV Spaces of analytic functions. Hurwitz's theorem. Montel's theorem. Riemann mappingtheorem. Weierstrass Factorization theorem.

Recommended Books:

1. L.V. Ahlfors: Complex Analysis, MCGraw - Hill, 1979.
2. D. Sarason: Complex Function Theory, Hindustan Book Agency, Delhi, 1994.
3. H. K. Pathak, Complex Analysis and Applications, Springer, 2019.

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. W.H.J. Fuchs, Topics in the Theory of Functions of one Complex Variable, D.Van Nostrand Co., 1967.
6. C.Caratheodory, Theory of Functions (2 Vols.) Chelsea Publishing Company, 1964.

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7. M.Heins, Complex Function Theory, Academic Press, 1968.
8. Walter Rudin, Real and Complex Analysis, McGraw-Hill Book Co., 1966..
9. E.C Titchmarsh, The Theory of Functions, Oxford University Press, London.
10. W.A. Veech, A Second Course in Complex Analysis, W.A. Benjamin, 1967.
11. S.Ponnusamy, Foundations of Complex Analysis, Narosa Publishing House, 1997.

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M. Sc. Mathematics (First Semester)
2024 - 2025
PAPER-V
Code- MMT 105

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). Homomorphism of Semigroups and monoids. Congruence relation and Quotient Semigroups. Subsemigroup and submonoids. Direct Products. Basic Homomorphism Theorem.

Unit-II 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-III 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-IV Grammars and Languages- Phrase–structure Grammars. Rewriting rules. Derivations. Sententia forms. Language generated by a Grammar. Regular, Context-Free and Context Sensitive Grammars and Languages. Regular sets. Regular expressions and the Pumping Lemma. Kleen's theorem. Notions of Syntax Analysis. Polish Notations. Conversion of Infix Expressions to Polish Notation. The Reverse Polish Notations.

Recommended Books:

1. Elements of Discrete Mathematics By C.L. Liu.
2. J.P. Tremblay & R. Manohar, Discrete Mathematical Structures with Applications to Computer Science, McGraw-Hill Book Co., 1997.

References:

1. C.L Liu, Elements of Discrete Mathematics, McGraw-Hill Book Co.
2. N. Deo. Graph Theory with Application to Engineering and Computer Sciences. Prentice Hall of India.
3. J. L. Gersting, Mathematical Structures for Computer Science, (3rd edition), Computer Science Press, New York.
4. Seymour Lepschutz, Finite Mathematics (International) edition 1983), McGraw-Hill Book Company, New York.
5. S.Wiitala, Discrete Mathematics-A Unified Approach, McGraw-Hill Book Co.

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