Progressive Education Society's
Modern College of Arts, Science and Commerce (Autonomous),
Shivajinagar, Pune - 5
Second Year of B.Sc. (Computer Science)
(2024 Course under NEP 2020)

Course Code: 24CsMatU3301
Course Name: Advanced Discrete Mathematics
Teaching Scheme: TH: 2 Hours/Week **Credit: 02**
Examination Scheme: CIA: 20 Marks **End-Semester: 30 Marks**

Prerequisites:

- Set, Logic, Permutations, Combinations, Counting principles, Algebra of equations, Properties of integers.

Course Objectives: To study

- Number theoretic problems using division algorithm for integers
- Euler's theorem and Fermat's theorem.
- Congruence relations on the set of integers.
- Permutations and combinations and its properties.
- First and second principle of Mathematical induction
- Posets, Lattices and types of lattices.
- Linear homogeneous recurrence relations.

Course Outcomes:

On completion of the course, student will be able to:-

- Find greatest common divisor of two integers
- Solve problems based on concept of Prime Integers
- Solve problems based on Residue classes.
- Find a remainder when one (relatively large) integer is divided by another (small integer)
- Solve problems based on counting principles.
- Check whether given set is a partially ordered set or not
- Check whether the given set is a lattice or not.
- Formulate a recurrence relation for recursive algorithm of a given real life situation
- Solve linear homogeneous recurrence relation.

Course Contents:

Chapter 1	**Divisibility of integers**	**10 Hours**
	● Division algorithm. ● Divisibility and its properties ● Primes ● Greatest Common Divisor and Least Common Multiple ● Euclidean algorithm. ● Relatively prime integers, Euclid lemma ● Congruence relation and its properties ● Residue classes modulo n ● Euler's and Fermat's theorems	
Chapter 2	**Counting Principles**	**10 Hours**
	● Basic Counting Principles ● Inclusion-Exclusion Principle. ● The Pigeonhole Principle ● Permutations and Combinations ● Distributions ● Mathematical Inductions	
Chapter 3	**Lattices and Boolean Algebra**	**5 Hours**
	● Poset and its representation ● Lattices ● Types of Lattices ● Boolean Algebra	
Chapter 4	**Recurrence Relations**	**5 Hours**
	● Introduction ● Modeling with Recurrence Relation ● Linear Homogeneous Recurrence Relations with constant coefficients	
	Total No. of Hours	**30**

Reference Books:

1) Discrete Mathematics and its Applications by Kenneth Rosen, Tata McGraw Hill (Seventh edition), 2011.
2) Discrete Mathematical Structures by Kolman, Busby and Ross, PHI Publications, (Sixth edition), 2009.
3) Elements of Discrete Mathematics by C. L. Liu and D. P. Mohapatra, Tata McGraw Hill (fourth edition), 2013.

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Course Code: 24CsMatU3302
Course Name: Lab Course on 24CsMatU3301
Teaching Scheme: PR: 4 Hours/Week Credit: 02
Examination Scheme: CIA: 20 Marks End-Semester: 30 Marks

Prerequisites:

- Set, Logic, Permutations, Combinations, Counting principles, Algebra of equations, Properties of integers.

Course Objectives: To study

- Number theoretic problems using division algorithm for integers
- Euler's theorem and Fermat's theorem.
- Congruence relations on the set of integers.
- Permutations and combinations and its properties.
- First and second principle of Mathematical induction
- Posets, Lattices and types of lattices.
- Linear homogeneous recurrence relations.

Course Outcomes:

On completion of the course, student will be able to:-

- Find greatest common divisor of two integers
- Solve problems based on concept of Prime Integers
- Solve problems based on Residue classes.
- Find a remainder when one (relatively large) integer is divided by another (small integer)
- Solve problems based on counting principles.
- Check whether the given set is a partially ordered set or not
- Check whether the given set is a lattice or not.
- Formulate a recurrence relation for recursive algorithm of a given real life situation
- Solve linear homogeneous recurrence relation.

Course Contents:

	List of Practicals	60 Hours
Practical 1	Divisibility	
Practical 2	Prime Numbers	
Practical 3	Euclidean Algorithm	
Practical 4	Congruence Relation	
Practical 5	Euler's and Fermat's Theorems	
Practical 6	The Pigeonhole Principle	
Practical 7	Permutations and Combinations	
Practical 8	Distributions	
Practical 9	The Inclusion-Exclusion Principle	
Practical 10	Mathematical Induction	
Practical 11	Partially Ordered Sets	
Practical 12	Lattices	
Practical 13	Boolean Algebra	
Practical 14	Modeling with Recurrence Relation	
Practical 15	Linear Homogeneous Recurrence Relations	

Note: For every batch there will be 4 hours for each practical session per week.

Reference Books:

1) Discrete Mathematics and its Applications by Kenneth Rosen, Tata McGraw Hill (Seventh edition), 2011.
2) Discrete Mathematical Structures by Kolman, Busby and Ross, PHI Publications, (Sixth edition), 2009.
3) Elements of Discrete Mathematics by C. L. Liu and D. P. Mohapatra, Tata McGraw Hill (fourth edition), 2013.

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Course Code: 24CsMatU4301
Course Name: Groups and Coding Theory
Teaching Scheme: TH: 2 Hours/Week **Credit: 02**
Examination Scheme: CIA: 20 Marks **End-Semester: 30 Marks**

Prerequisites:
- Set theory, Matrix Algebra.

Course Objectives: To study
- Binary operations
- Semigroup and monoid
- Group
- Types of groups
- Coding theory
- Cryptography

Course Outcomes: On completion of the course, student will be able to:-
- Learn binary operations
- Understand group structure
- Solve problems based on types of groups
- Understand encoding and decoding process
- Detect errors in coding and decoding
- Study Public Key Cryptosystem

Course Contents:

Chapter 1	**Introduction to Algebraic Structures**	**6 Hours**
	• Binary Operations • Semigroup, Monoid • Group • Properties of Group	
Chapter 2	**Groups and Subgroups**	**10 Hours**

	• Subgroups • Cyclic groups • Abelian groups • Permutation groups • Normal subgroups • Quotient Groups	
Chapter 3	**Coding Theory**	**8 Hours**
	• Coding of Binary information and error detection • Group Codes, Hamming codes, Polynomial codes, Block codes, Linear codes • Decoding and Error correction	
Chapter 4	**Cryptography**	**6 Hours**
	• Simple Cryptosystems • Enciphering Matrices • The Public key Cryptography: Introduction • RSA cryptosystem • Knapsack	
	Total No. of Hours	**30**

Reference Books:

1) Contemporary Abstract Algebra by Joseph A. Gallian, Narosa Publishing House, Fourth edition
2) Discrete Mathematical Structures by Kolman, Busby and Ross, PHI Publication, Sixth edition
3) A Course in Number Theory and Cryptography by Neal Koblitz, Springer-Verlag Publication
3) Applied Discrete Structures for Computer Science by Alan Doerr and Kenneth Levasseur, Science Research Associates Publications (Paperback edition)
4) https://archive.nptel.ac.in/courses/108/104/108104092/

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Course Code: 24CsMatU4302
Course Name: Lab Course on 24CsMatU4301
Teaching Scheme: PR: 4 Hours/Week **Credit: 02**
Examination Scheme: CIA: 20 Marks **End-Semester: 30 Marks**

Prerequisites:

- Set theory, Matrix Algebra.

Course Objectives:

To study

- Binary operations
- Semigroup and monoid
- Group
- Types of groups
- Coding theory
- Cryptography

Course Outcomes:

On completion of the course, student will be able to:-

- Learn binary operations
- Understand group structure
- Solve problems based on types of groups
- Understand encoding and decoding process
- Detect errors in coding and decoding
- Study public key Cryptosystem

Course Contents:

	List of Practicals	**60 Hours**
Practical 1	Binary Operations	
Practical 2	Semigroups and Monoids	
Practical 3	Groups and Subgroups	
Practical 4	Cyclic groups	
Practical 5	Permutation groups	
Practical 6	Quotient Groups	
Practical 7	Group theory using **GAP** software	
Practical 8	Group and Hamming Codes	
Practical 9	Polynomial, Block and Linear Codes	
Practical 10	Detection of errors	
Practical 11	Correction of errors	
Practical 12	Public Key Cryptography	
Practical 13	RSA Cryptosystem and Digital Signature	
Practical 14	Knapsack Cryptosystem	
Practical 15	Coding Theory using **Sage** software	

Note: For every batch there will be 4 hours for each practical session per week.

Reference Books:

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4) https://archive.nptel.ac.in/courses/108/104/108104092/