Progressive Education Society's

Modern College of Arts, Science and Commerce,

Shivajinagar, Pune 5

(An Autonomous College Affiliated to SavitribaiPhule Pune University)

Detailed Syllabus

For B.Sc. (Computer Science)

(Mathematics)

(2019-20 Course)

(with effect from 2019-20)

CIA: Continuous Internal Evaluation

Semester 1 (First Year)

Course Type	Course Code	Course / Paper Title	Hours / Week	Credit	CIA	End Sem Exam	Total
CCT-1	19CsMatU101	Discrete Mathematics	3	2	40	60	100
CCT-2	19CsMatU102	Algebra	3	2	40	60	100
CCP-1	19CsMatU103	Mathematics Practical – I	4	2	40	60	100
	Total		**10**	**6**	**120**	**180**	**300**

Semester 2 (First Year)

Course Type	Course Code	Course / Paper Title	Hours / Week	Credit	CIA	End Sem Exam	Total
CCT-3	19CsMatU201	Graph Theory	3	2	40	60	100
CCT-4	19CsMatU202	Calculus	3	2	40	60	100
CCP-2	19CsMatU203	Mathematics Practical – II	4	2	40	60	100
	Total		**10**	**6**	**120**	**180**	**300**

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Modern College of Arts, Science and Commerce (Autonomous), Shivajinagar, Pune - 5

First Year of B.Sc. (Computer Science) (Mathematics) (2019 Course)

Course Code: 19CsMatU101
Course Name: Discrete Mathematics

Teaching Scheme: TH: 3 Hours/Week **Credit: 02**

Examination Scheme: CIA: 40 Marks **End-Sem: 60 Marks**

Prerequisites: Set, Logic, Permutations, Combinations, Counting principles, Algebra of equations.

Course Objectives: To study

- Logic, Predicates and quantifiers, Rules of inference.
- Posets, Lattices and types of lattices.
- Permutations and combinations and its properties.
- First and second principle of mathematical induction
- Linear homogeneous recurrence relations.

Course Outcomes:

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

- Apply different methods of proofs.
- Check whether given set is a lattice or not.
- Solve problems based on counting principles.
- Solve linear homogeneous recurrence relation.

Course Contents:

Chapter 1	**Logic**	7 lectures
	• Revision: Propositional logic, Propositional equivalences. • Predicates and Quantifiers: Predicate, n-Place Predicate or,n-ary Predicate, Quantification and Quantifiers, Universal Quantifier, Existential Quantifier, Quantifiers with restricted domains, Logical Equivalences involving Quantifiers. • Rules of Inference: Argument in propositional Logic, Validity of an Argument, Direct and Indirect	

	methods of proofs, Rules of Inference for Propositional Logic, Building Arguments.	
Chapter 2	**Lattices and Boolean Algebra**	10 lectures
	• Poset, Hasse diagram. • Lattices, Complemented lattice, Bounded lattice and Distributive lattice – Definition and examples. • Boolean Functions: Introduction, Boolean variable, Boolean Function of degree n, Boolean identities, Definition of Boolean Algebra and examples. • Representation of Boolean Functions: Minterm, Maxterm, Disjunctive Normal form, Conjunctive Normal Form.	
Chapter 3	**Counting Principles**	12 lectures
	• Cardinality of a Set: Cardinality of a finite set. • Basics of Counting: The Sum Rule,the Product Rule, the Inclusion-Exclusion Principle. • The Pigeonhole Principle: Statement, the Generalized Pigeonhole Principle, Its Applications. • Permutations and Combinations : Permutation and Combination with Repetitions, Permutations with Indistinguishable Objects, Distributing objects into boxes: Distinguishable objects and distinguishable boxes, Indistinguishable objects and distinguishable boxes, Distinguishable objects and Indistinguishable boxes, Indistinguishable objects and Indistinguishable boxes • Method of first and second principle of Mathematical Induction, Examples.	
Chapter 4	**Recurrence Relations**	6 lectures
	• Recurrence Relations: Introduction, Formation. • Linear Recurrence Relations with constant coefficients. • Homogeneous Solutions.	
Guidance / Discussion on course specific experiential learning through field work		01 lecture
	Total No. of Lectures	**36**

Reference Books:

1) Discrete Mathematics and it's Applications by Kenneth Rosen, Tata McGraw Hill (Seventh edition),2011.
2) Elements of Discrete Mathematics by C. L. Liu and D. P. Mohapatra, Tata McGraw Hill (fourth edition), 2013.

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First Year of B.Sc. (Computer Science) (Mathematics) (2019 Course)

Course Code: 19CsMatU102
Course Name: Algebra

Teaching Scheme: TH: 3 Hours/Week **Credit: 02**

Examination Scheme: CIA: 40 Marks **End-Sem: 60 Marks**

Prerequisites: Matrices, Set theory, Properties of integers.

Course Objectives: To Study

- System of linear equations.
- Number theoretic problemsusing division algorithm for integers, Euler's theorem and Fermat's theorem.
- Congruence relation on the set of integers.
- Groups and types of groups.

Course Outcomes:

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

- Solve system of linear equations.
- Find rank of a matrix.
- Find greatest common divisor of two integers.
- Check whether given set is a group or not.

Course Contents:

Chapter 1	**Matrices and system of linear equations**	14 lectures
	• Echelon form of a matrix. • System of linear equations: Gauss elimination method, Gauss –Jordan elimination method, LU decomposition method. • Rank of a matrix, Row rank, Column rank.	
Chapter 2	**Divisibility of integers**	12 lectures
	• Division algorithm. • Divisibility and its properties, prime numbers. • Definition G.C.D. and L.C.M., Expressing G.C.D. of two integers as a linear combination	

	of the two integers. • Euclidean algorithm. • Relatively prime integers, Euclid lemma and its generalization. • Congruence relations and its properties, Residue classes: Definition, Examples, Addition and multiplication modulo n and composition tables. • Euler's and Fermat's theorems, Examples.	
Chapter 3	**Binary operations and groups**	09 lectures
	• Definition of binary operation, Examples, properties of binary operations. • Definition of Semigroup, Monoid, Examples. • Definition of group, types of groups and examples: finite and infinite groups, Permutation groups, Subgroups, Cyclic groups.	
Guidance / discussion on course specific experiential learning through field work		01 lecture
	Total no. of lectures	**36**

Reference Books:

1) Elementary Linear Algebra (Applications Version) by Howard Anton and Chris Rorres, John Wiley & Sons Inc. (Ninth Edition), 2005

2) Elements of Discrete Mathematics by C. L. Liu and D. P. Mohapatra, Tata McGraw Hill (fourth edition), 2013.

3) A First Course in Abstract Algebra by J.B. Fraleigh, Narosa Publishing house, New Delhi (Third edition), 1990.

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First Year of B.Sc. (Computer Science) (Mathematics) (2019 Course)

Course Code: 19CsMatU103
Course Name: Mathematics Practical - I

Teaching Scheme: TH: 3 Hours/Week **Credit: 02**

Examination Scheme: CIA: 40 Marks **End-Sem: 60 Marks**

Prerequisite Courses: Discrete mathematics, Algebra.

Course Objectives:

- The student should be able to solve problems depending on contents in Discrete Mathematics and Algebra.
- To introduce Free and Open source Mathematical Software: Scilab.

Course Outcomes:

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

- Understand the theoretical concepts in Discrete Mathematics and Algebra.
- Apply this knowledge in various courses of Computer Science.
- Solve problems of Linear Algebra using Scilab.

Course Contents:

	List of practical	48 Lectures
Practical 1	Logic	
Practical 2	Lattices	
Practical 3	Boolean Algebra	
Practical 4	Counting Principles	
Practical 5	Recurrence Relations	
Practical 6	Introduction to Scilab-I	
Practical 7	Matrices and System of Linear Equations	
Practical 8	Divisibility of Integers-I	
Practical 9	Divisibility of Integers-II	
Practical 10	Binary Operations	
Practical 11	Groups	
Practical 12	Introduction to Scilab-II	

Note: There will be 4 lecturesfor each practical session per week.

Reference Books:

1) Discrete Mathematics and It's Applications by Kenneth Rosen, Tata McGraw Hill (Seventh edition), 2011.

2) Elements of Discrete Mathematics by C. L. Liu and D. P. Mohapatra, Tata McGraw Hill (fourth edition), 2013.

3) Elementary Linear Algebra (Applications Version) by Howard Anton, Chris Rorres. John Wiley & Sons Inc.(Ninth Edition), 2005

4) A First Course in Abstract Algebra by J.B. Fraleigh, Narosa Publishing house, New Delhi (Third edition), 1990.

5) Modeling and Simulations in Scilab/Scicos by Stephen Campbell, Jean Philippe Chanceller, RamineNikoukhah, Springer, 2006.

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First Year of B.Sc. (Computer Science) (Mathematics) (2019 Course)

Course Code: 19CsMatU201
Course Name: Graph Theory

Teaching Scheme: TH: 3 Hours/Week **Credit: 02**

Examination Scheme: CIA: 40 Marks **End-Sem: 60 Marks**

Prerequisite: Set Theory.

Course Objectives: To Study

- Graphs, Types of graphs.
- Operations on graphs(Union, Intersection, Ring sum and Product).
- Connected graphs and its properties.
- Trees and its properties.

Course Outcomes:

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

- Convert real life problems into graph theoretical models.
- Check whether two graphs are isomorphic or not.
- Apply basic operations on graphs and connected graphs.
- Identify Eulerian and Hamiltonian graphs.
- Find shortest spanning tree for a given graph.

Course Contents:

Chapter 1	**Graphs**	6 lectures
	• Definition, Elementary terminologies and results, Graphs as Models. • Special types of graphs. • Isomorphism. • Adjacency and Incidence matrix of a Graph.	
Chapter 2	**Operations on Graphs**	4lectures
	• Subgraphs, Induced subgraphs,Vertex deletion, Edge deletion. • Complement of a graph and self-complementary graphs. • Union, Intersection, Ring sum and Product of graphs.	

	• Fusion of vertices.	
Chapter 3	**Connected Graphs**	10 lectures
	• Walk, Trail, Path and Cycle: Definitions and elementary properties. • Connected Graphs: Definition and properties. • Distance between two vertices, Eccentricity, Center, Radius and diameter of a graph. • Isthmus, Cutvetex: Definition and properties. • Cutset, Edge-connectivity, Vertex connectivity. • Weighted Graph and Dijkstra's algorithm.	
Chapter 4	**Eulerian and Hamiltonian Graphs**	5 lectures
	• Seven bridge problem, Eulerian Graph: Definition and examples, Necessary and sufficient condition. • Fleury's algorithm. • Hamiltonian Graphs: Definition and examples, Necessary condition. • Chinese postman problem and travelling salesman problem.	
Chapter 5	**Trees**	10 lectures
	• Definition, Properties of trees. • Center of a tree. • Binary Tree: Definition, Examples and properties. • Tree traversal: Ordered rooted tree, Preorder traversal, Inorder traversal and Postorder traversal, Prefix notation. • Spanning Tree: Definition, Properties, Shortest spanning tree, Kruskal's algorithm.	
Guidance / Discussion on course specific experiential learning through field work		01 lecture
	Total No. of Lectures	**36**

Reference Books:

1) A First Look at Graph Theory by John Clark and Derek Holton, Allied Publishers (1st Indian edition), 1995.

2) Graph Theory with Applications to Computer Science and Engineering by Narsingh Deo, Prentice Hall of India (3rd Indian edition), 1986.

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First Year of B.Sc. (Computer Science) (Mathematics) (2019 Course)

Course Code: 19CsMatU202
Course Name: Calculus

Teaching Scheme: TH: 3 Hours/Week **Credit: 02**

Examination Scheme: CIA: 40 Marks **End-Sem: 60 Marks**

Prerequisites: Sets, Relation, Function, Continuity, Differentiability.

Course Objectives: To Study

- Relations and types of relations.
- Functions and types of functions.
- Continuity, derivative and its geometrical interpretation.
- Applications of mean value theorems and successive differentiation.
- Taylor's theorem, Maclaurin's theorems and its applications.

Course Outcomes:

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

- Understand various properties of relations and functions.
- Understand concept and application of continuity, differentiability and mean value theorems.
- Use n^{th} derivative of real valued function of real variable.
- Expand various elementary functions as power series.

Course Contents:

Chapter 1	**Relations and Functions**	11 lectures
	• Relations, Types of relations, Equivalence relations. Partial ordering. • Equivalence Class, Properties and partition of a set. • Transitive closure and Warshall's Algorithm. • Digraph of a relation, Matrix representation and composition of relations. • Definition of a function as a relation, Types of	

	functions.	
Chapter 2	**Continuity and Differentiability**	12 lectures
	• Continuity and properties of continuous functions defined on [a, b] and examples. • Differentiability. • Intermediate value theorem. • Rolle's mean value theorem. • Lagrange's mean value theorem. • Cauchy's mean value theorem. • Verification of mean value theorems using examples. • L' Hospital's rule and it's application.	
Chapter 3	**Successive Differentiation**	06 lectures
	• The n^{th} derivatives of standard functions. • Leibnitz's theorem and applications.	
Chapter 4	**Taylor's and Maclaurin's theorems**	06 lectures
	• Taylor's and Maclaurin's theorems with Lagrange's and Cauchy's form of remainders. • Taylor's and Maclaurin's Series.	
Guidance / Discussion on course specific experiential learning through field work		01 lecture
	Total No. of Lectures	**36**

Reference Books:

1) Discrete Mathematics Structure by Bernard Kolman, Robert Busby, Sharon Cutler Ross, Nadeem-ur-Rehman, Pearson Education (6^{th} Edition), 2009.

2) Calculus and Analytical Geometry by Thomas Finny, Narosa Publishing House (6^{th} edition), 1998.

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First Year of B.Sc. (Computer Science) (Mathematics) (2019 Course)

Course Code: 19CsMatU203
Course Name: Mathematics Practical –II

Teaching Scheme: TH: 3 Hours/Week **Credit: 02**

Examination Scheme: CIA: 40 Marks **End-Sem: 60 Marks**

Prerequisite Courses: Graph Theory, Calculus.

Course Objectives: To solve problems depending on contents in Graph theory and Calculus.

Course Outcomes:

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

- Understand the theoretical concepts in Graph theory and Calculus.
- Apply this knowledge in various courses of Computer Science.

Course Contents:

	List of Practical	48 lectures
Practical 1	Graphs and operations on graphs	
Practical 2	Connected graphs	
Practical 3	Eulerian and Hamiltonian graphs	
Practical 4	Trees-I	
Practical 5	Trees-II	
Practical 6	Introduction to Scilab-III	
Practical 7	Relations and Functions	
Practical 8	Continuity and Differentiability	
Practical 9	Mean value theorems and L'Hospital rule	
Practical 10	Successive differentiation	

Practical 11	Taylor's and Maclaurin's theorems	
Practical 12	Introduction to Scilab-IV	

Note: There will be 4 lecturesfor each practical session per week.

Reference Books:

1) A First Look at Graph Theory byJohn Clark and Derek Holton, Allied Publishers (1^{st} Indian edition), 1995.

2) Graph Theory with Applications to Computer Science and Engineering by Narsingh Deo, Prentice Hall of India (3^{rd} Indian edition), 1986.

3) Discrete Mathematics Structure by Bernard Kolman, Robert Busby, Sharon Cutler Ross, Nadeem-ur-Rehman, Pearson Education (6^{th} Edition), 2009.

4) Calculus and Analytical Geometry by Thomas Finny, Narosa Publishing House (6^{th} edition), 1998.

5) Modeling and Simulations in Scilab/Scicos by Stephen Campbell, Jean Philippe Chanceller, RamineNikoukhah, Springer, 2006.