Discrete Mathematics	Code & No:	MATH 111
	Credits:	3(3,0,1)
	Pre-requisite:	None
	Co-requisite:	None
	Level:	3

Course Description:

This course includes the following topics:

1) **Set Theory and Elementary logic**: Sets and Elements, Subsets, Various types of sets, Venn Diagrams, Set Operations, Algebra of Sets, Cartesian product of sets, Duality, Finite Sets, Counting Principle, Power Sets, Propositions and Compound Statements, Basic Logical Operations, Truth Tables, Tautologies and Contradictions, Logical Equivalence, Algebra of Propositions, Conditional and Bi-conditional Statements, Arguments, Propositional Functions, logic gates
2) **Methods of proof**: Proof Strategy, Direct and indirect proofs, the Contrapositive Method, the Contradiction Method, Mathematical Induction
3) **Relations**: Basic definitions on relations, Types of relations, Codomain and Range of a functions, Pictorial Representatives of Relation, Equivalence relation and set partition, Partial Ordering,
4) **Functions, Algorithms and Integers**: Definition of Function, Types of functions, Domain, Codomain and Range of a functions, Composition of functions, recursively defined functions, Ackermann function, Algorithms, Examples of Algorithms, Complexity of Algorithms, Recursive Algorithms, Integers, Division, Congruencies, Representation of Integers, Integers Algorithms, The Euclidean Algorithm
5) **Groups and Ring**: Algebraic structure, binary composition and its properties, Abelian group, properties of group, permutation of groups, Subgroups, Cyclic group and rings

   Graph theory: Introduction to Graphs, Representation of Graphs, Paths and Cycles, Euler and Hamilton Paths, Shortest-Path Algorithms, Planar Graph, Graph Coloring

Course Aims:

1. Give the intuitive knowledge of sets, elementary logics and their operations, Study the fundamental concepts of various methods of proof
2. Understand relations, equivalence relations and partial ordering
3. Develop skills to solve problems related to functions, algorithm and integers
4. To get the fundamental knowledge of groups, type of groups and ring
5. Understand about graphs and Path

Student Outcomes (SOs):

☒(a) An ability to apply knowledge of computing and mathematics appropriate to the program's student outcomes and to the discipline

☒(b) An ability to analyze a problem, and identify and define the computing requirements appropriate to its solution

☐(c) An ability to design, implement, and evaluate a computer-based system, process, component, or program to meet desired needs

☐(d) An ability to function effectively on teams to accomplish a common goal

☐(e) An understanding of professional, ethical, legal, security and social issues and responsibilities

☐(f) An ability to communicate effectively with a range of audiences

☐(g) An ability to analyze the local and global impact of computing on individuals, organizations, and society

☐(h) Recognition of the need for and an ability to engage in continuing professional development

☒(i) An ability to use current techniques, skills, and tools necessary for computing practice.

☐(j) An ability to apply mathematical foundations, algorithmic principles, and computer science theory in the modeling and design of computer-based systems in a way that demonstrates comprehension of the tradeoffs involved in design choices. [CS]

☐(k) An ability to apply design and development principles in the construction of software systems of varying complexity. [CS]

☐(j) An ability to use and apply current technical concepts and practices in the core information technologies of human computer interaction, information management, programming, networking, and web systems and technologies. [IT]

☐(k) An ability to identify and analyze user needs and take them into account in the selection, creation, evaluation, and administration of computer-based systems. [IT]

☐(l) An ability to effectively integrate IT-based solutions into the user environment. [IT]

☐(m) An understanding of best practices and standards and their application. [IT]

☐(n) An ability to assist in the creation of an effective project plan. [IT]

Course Learning Outcomes (CLOs):

Upon successful completion of the course, students should be able to:

1. Give the intuitive knowledge of sets, elementary logics and their operations, Study the fundamental concepts of various methods of proof

2. Understand relations, equivalence relations and partial ordering
3. Develop skills to solve problems related to functions, algorithm and integers
4. To get the fundamental knowledge of groups, type of groups and ring
5. Understand about graphs and Path

SOs and CLOs Mapping:

CLO/SO	a	b	c	d	e	f	g	h	i	j	k	l	m	n
CLO1	√	√												
CLO2	√								√					
CLO3		√							√					
CLO4	√								√					
CLO5	√	√							√					

No.	Topics	Weeks	Teaching hours
1	**Set Theory and Elementary logic**: Sets and Elements, Subsets, Various types of sets, Venn Diagrams, Set Operations, Algebra of Sets, Cartesian product of sets, Duality, Finite Sets, Counting Principle, Power Sets, Propositions and Compound Statements, Basic Logical Operations, Truth Tables, Tautologies and Contradictions, Logical Equivalence, Algebra of Propositions, Conditional and Bi-conditional Statements, Arguments, Propositional Functions, logic gates	2	6
2	**Methods of proof**: Proof Strategy, Direct and indirect proofs, the Contrapositive Method, the Contradiction Method, Mathematical Induction	2	6
3	**Relations:** Basic definitions on relations, Types of relations, Codomain and Range of a functions, Pictorial Representatives of Relation, Equivalence relation and set partition, Partial Ordering,	2	6
4	**Functions, Algorithms and Integers**: Definition of Function, Types of functions,	3	9

	Domain, Codomain and Range of a functions, Composition of functions, recursively defined functions, Ackermann function, Algorithms, Examples of Algorithms, Complexity of Algorithms, Recursive Algorithms, Integers, Division, Congruencies, Representation of Integers, Integers Algorithms, The Euclidean Algorithm		
5	**Groups and Rings**: Algebraic structure, binary composition and its properties, Abelian group, properties of group, permutation of groups, Subgroups, Cyclic group and rings	2	6
6	**Graph theory**: Introduction to Graphs, Representation of Graphs, Paths and Cycles, Euler and Hamilton Paths, Shortest-Path Algorithms, Planar Graph, Graph Coloring	3	9
	Total	**14**	**42**

Textbook:

- Discrete Mathematics and Its Applications by K. Rosen, Mc Graw-Hill, 7 edition (June 14, 2011)
- Schaum's Series outline of Theory and Problems of DISCRETE MATHEMATICS by Seymour Lipschutz and Marc Lars Lipson, Third Edition, McGraw -Hill, 2007

Essential references:

- Essentials of Discrete Mathematics by James L. Hein, Jones and Barlett, 3rd Edition, (2017)
- Discrete Mathematics for Computer Scientists, by Stein, Drysdale, and Bogart, Pearson, (2011)
- Discrete Mathematical Structures, by Kolman, Busby, and Ross, Pearson, 6th Edition, (2009)