Department of Computer Science and Engineering
National Institute of Technology Tiruchirappalli

1.Course Outline			
Course Title	Mathematical Foundations of Computer Science		
Course Code	CAS761		
Department	CA	**No. of Credits**	3
Pre-requisites Course Code	NIL	**Faculty Name**	Arish. P
PAC Chairman	Dr. S. Sangeetha		
E-mail	arish@nitt.edu	**Telephone No.**	+91-9677376606
Course Type	Core Course		

2. Course Overview

Mathematical Foundations of Computer Science familiarizes a broad range of mathematical objects like sets, functions, relations, graphs, that are omnipresent in computer science. This course will discuss fundamental concepts and tools in discrete mathematics with emphasis on their applications to computer science. Perhaps more importantly, the students will reach a certain level of mathematical maturity - being able to understand formal statements and their proofs; coming up with rigorous proofs themselves; and coming up with interesting results. The main topics of this course are (1) sets, functions, relations, (2) logic and propositions, (3) groups, rings and fields, (4) basic number theory and (5) graph theory.

3. Course Objectives

- Apply the operations of sets and use Venn diagrams to solve applied problems; solve problems using the principle of inclusion-exclusion.
- Describe binary relations between two sets; determine if a binary relation is reflexive, symmetric, or transitive or is an equivalence relation; combine relations using set operations and composition.
- Describe N-ary relations between N sets and apply basic database operations such as projections to N-ary relations.
- Determine the domain and range of a discrete or non-discrete function, graph functions, identify one-to-one functions, perform the composition of functions, find and/or graph the inverse of a function, and apply the properties of functions to application problems.
- Simplify and evaluate basic logic statements including compound statements, implications, inverses, converses, and contrapositives using truth tables and the properties of logic.
- Express a logic sentence in terms of predicates, quantifiers, and logical connectives
- Apply rules of inference, tests for validity, and methods of proof including direct and indirect proof forms, proof by contradiction, proof by cases, and mathematical

induction and write proofs using symbolic logic and Boolean Algebra.

- Demonstrate understanding of the idea of a group, a ring and an integral domain, and be aware of examples of these structures in mathematics.
- Appreciate and be able to prove the basic results of group theory and ring theory.
- Understand and be able to apply the fundamental theorem of finite abelian groups.
- Appreciate the significance of unique factorization in rings and integral domains.
- Use elementary number theory including the divisibility properties of numbers to determine prime numbers and composites, the greatest common divisor, and the least common multiple; perform modulo arithmetic and computer arithmetic.
- Identify the base step and the recursive or inductive step in applied problems and give a recursive and a non-recursive definition for an iterative algorithm.
- Determine if a given graph is simple or a multigraph, directed or undirected, cyclic or acyclic, and determine the connectivity of a graph.
- Represent a graph using an adjacency list and an adjacency matrix and apply graph theory to application problems such as computer networks.
- Determine if a graph has an Euler or a Hamilton path or circuit.

4. Course Outcomes (CO)

Student will be able to:

- Describe the concepts of sets, relations and functions.
- Write an argument using logical notation and determine if the argument is or is not valid.
- Develop an abstract approach to reasoning about number systems, their arithmetic structures and properties.
- Understand and relate basic properties of graphs and related discrete structures to practical examples.
- Identify when and how to use the t-test, F-test and Chi-Square Test and Analysis of variance – one way and two way classifications.

5. Course Outcome (CO)	Aligned Programme Outcome (PO)											
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
Describe the concepts of sets, relations and functions.		L	H					M				
Write an argument using logical notation and determine if the argument is or is not valid.	L			M		H						
Develop an abstract approach to reasoning about number systems, their arithmetic structures and properties.		H			L				M			
Understand and relate basic properties of graphs and related discrete structures to practical examples.		M		H						L		

6. Course Teaching and Learning Activities			
Week	**No. of Classes**	**Topic Covered**	**Mode of Delivery**
1	Class-I	Sets and operations, properties	Chalk and Talk , Power Point Presentation
	Class-II	Power set, methods of proof	Chalk and Talk , Power Point Presentation
	Class-III	Relations, graph and matrix of a relation	Chalk and Talk , Power Point Presentation
2	Class-I	Partial and total orders, well ordering	Chalk and Talk , Power Point Presentation
	Class-II	Equivalence relations, 1 -1, onto functions	Chalk and Talk , Power Point Presentation
	Class-III	Bijective - composition of relations and functions - inverse functions	Chalk and Talk , Power Point Presentation
3	Class-I	Propositions and logical operators	Chalk and Talk , Power Point Presentation
	Class-II	Truth table, Equivalences and implications	Chalk and Talk , Power Point Presentation
	Class-III	Basic laws, Functionally complete set of connectives	Chalk and Talk , Power Point Presentation
4	Class-I	Propositional Calculus	Chalk and Talk , Power Point Presentation
	Class-II	Validity, Satisfiability related concepts	Chalk and Talk , Power Point Presentation
	Class-III	Conversion of arbitrary propositional formula to CNF or DNF	Chalk and Talk , Power Point Presentation
5	Class-I	Introduction-Algebraic Structures	Chalk and Talk , Power Point Presentation
	Class-II	Groups, Abelian Group	Chalk and Talk , Power Point Presentation
	Class-III	Order, Cyclic Group,	Chalk and Talk , Power Point Presentation
6	Class-I	Homomorphism (Definition), Isomorphism (Definition),	Chalk and Talk , Power Point Presentation
	Class-II	Kernel of f (Definition), Rings, Field and its Axioms	Chalk and Talk , Power Point Presentation
	Class-III	Sub-fields, Finite Fields, Powers and primitive roots in finite fields.	Chalk and Talk , Power Point Presentation
7	Class-I	Basic Number Theory Notions, Prime Number Theorem, GCD	Chalk and Talk , Power Point Presentation
	Class-II	Euclidean algorithm, Solving ax + by = d	Chalk and Talk , Power Point Presentation
	Class-III	Congruence, The Chinese Remainder Theorem, Modular Exponentiation	Chalk and Talk , Power Point Presentation
8	Class-I	Fermat and Euler , Primitive Roots	Chalk and Talk , Power Point Presentation
	Class-II	Inverting Matrices Mod n, Square Roots Mod n	Chalk and Talk , Power Point Presentation
	Class-III	Legendre and Jacobi Symbols, Perfect Numbers	Chalk and Talk , Power

		and Mersenne Numbers	Point Presentation
9	Class-I	Graph Theory : Definitions and basic results	Chalk and Talk , Power Point Presentation
	Class-II	Representation of a graph by a matrix and adjacency list	Chalk and Talk , Power Point Presentation
	Class-III	Trees, Cycles, Properties, Paths and connectedness	Chalk and Talk , Power Point Presentation
10	Class-I	Sub graphs, Graph Isomorphism	Chalk and Talk , Power Point Presentation
	Class-II	Operations on graphs, Vertex and edge cuts, Vertex and edge connectivity	Chalk and Talk , Power Point Presentation
	Class-III	Spanning Trees, Euler circuits, Hamiltonian graphs	Chalk and Talk , Power Point Presentation

7. Course Assessment Methods – Theorey

Sl. No.	Mode of Assessment	Week/Date	Duration	Weightage(%)
1.	Cycle Test –1	6th week	60 mins	20
2.	Cycle Test –2	12th week	60 mins	20
3.	Assignment	7thand 10thweek	7 days	10
4.	End Semester Exam	-	180 mins	50
			Total	100

8. Essential Readings (Textbooks, Reference books, Websites, Journals, etc.)

REFERENCES:

1. Kenneth H. Rosen, "Discrete Mathematics and Its Applications", 7th Edition, McGraw-Hill, 2012.
2. Mahima Ranjan Adhikari and Avishek Adhikari, "Basic Modern Algebra with Applications", Springer, 2014.
3. Kolman, Busby and Ross, "Discrete Mathematical Structures", 6th Edition, PHI, 2009.

9. Course Exit Survey (mention the ways by which the feedback about the course is assessed and indicate the attainment level)

1. The students through the class rep may give their feedback at any time to the course co-ordinator which will be duly addressed.
2. The students may also give their feedback during Class Committee meeting.
3. 'Course Outcome Survey' form will be distributed on the last working day to all the students and the feedback on various rubrics will be analyzed.
4. The COs will be computed after arriving at the final marks.

10. Course Policy (including plagiarism, academic honesty, attendance, etc.)

- **Plagiarism**
  The students are expected to come out with their original code for problems given assignments during the class work, and tests/examinations. If found to copy from internet/other students, zero marks will be assigned.

- **Attendance**
  100% is a must. However, relaxation will be given for leave on emergency requirements (medical, death, etc.) and representing institute events. Minimum 75% is required.

- **Academic Honesty**
  i. Possession of any electronic device, if any, found during the test or exam, the student will be debarred for 3 years from appearing for the exam and this will be printed in the Grade statement/Transcript.
  ii. Tampering of MIS records, if any, found, then the results of the student will be with held and the student will not be allowed to appear for the Placement interviews conducted by the Office of Training & Placement, besides (i).

11. Additional Course Information

- The students can get their doubts clarified at any time with their faculty member with prior appointment.

For Senate's Consideration

Arish. P	Dr. S. Sangeetha	Dr. S. R. Balasundaram
Course Faculty	Class Committee Chairperson	HOD