JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTHAPURAMU

COLLEGE OF ENGINEERING (AUTONOMOUS) :: PULIVENDULA

Course Code	**:**	15ACS11			
Course Title	**:**	**Discrete Mathematics**			
Course Structure	**:**	Lectures	Tutorials	Practicals	Credits
		4	0	0	4
Course Coordinator	**:**	Sri D.Raghunath Kumar Babu Asst-professor(Adhoc)			
Team of Instructors	**:**	Dr.G.Murali(HOD)			

I. Course Overview:

This course will discuss fundamental concepts and tools in discrete mathematics with emphasis on their applications to computer science. Topics include logic and Boolean circuits, sets, functions, relations, deterministic algorithms and randomized algorithms, analysis techniques based on counting methods and recurrence relations, trees and graphs.

II. Prerequisite(s):

1. Familiarity of concepts of statements logic and truth tables
2. Familiarity of concepts of sets, functions and relations
3. Counting principles, permutations and combinations
4. Basic concepts of graphs and trees

III. Assessment:

FORMATIVE ASSESMENT	
Mid Semester Test I for 20 Marks in first 2(1/2) units is conducted at18/01/2020 the end of 9th week. Mid Semester Test II for 20 Marks in last 2(1/2) units is conducted at 26/03/2020 end of the course work. Average of two tests is taken as final(80% & 20%)	20 Marks
Multiple Choice Test in all Units is conducted along with Mid Semester Test I & Test II for 10Marks	10 Marks
Total (Formative)	30 Marks
SUMMATIVE ASSESMENT	
End Semester Examination in all units is conducted for 70 Marks	70 marks
Grand Total	100 Marks

IV. Course objectives:

1	To introduce the concepts of mathematical logic
2	To introduce the concepts of sets, relations, and functions.
3	To perform the operations associated with sets, functions, and relations.
4	To introduce generating functions and recurrence relations.
5	To relate practical examples to the appropriate set, function, or relation model, and interpret the associated operations and terminology in context. To use Graph Theory for solving problems

V. Course Outcomes:

S.NO	Description	Bloom's taxonomy level
1	Ability to apply mathematical logic to solve problems	Knowledge, Understand(Level1, Level2)
2	Understand sets, relations, functions and discrete structures	Apply, Create (Level 3, Level 6)
3	Able to use logical notations to define and reason about fundamental mathematical concepts such as sets relations and functions	Evaluate (Level 3)
4	Able to formulate problems and solve recurrence relations	
5	Able to model and solve real world problems using graphs and trees	Analyze (Level 4)

VI: HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes (PO)		**Level**	**Proficiency assessed by**
PO1	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	3	Assignments, Tutorials, Mock Tests
PO2	**Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	3	Assignments, Tutorials, Mock Tests
PO3	**Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.	3	Assignments, Tutorials, Mock Tests

PO4	**Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	-	
PO5	**Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.	-	
PO6	**The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.	3	Assignments, Tutorials, Mock Tests --
PO7	**Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.	2	Assignments, Tutorials,
PO8	**Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.	1	Assignments
PO9	**Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.	-	--
PO10	**Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.	-	--
PO11	**Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.	-	--
PO12	**Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.	2	Assignments, Tutorials

VII: HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Specific Outcomes (PSO)		Level	Proficiency assessed by
PSO1	**Software Development and Research Ability:** Ability to understand the structure and development methodologies of software systems. Possess professional skills and knowledge of software design process. Familiarity and practical competence with a broad range of programming language and open source platforms. Use knowledge in various domains to identify research gaps and hence to provide solution to new ideas and innovations.	3	Lectures, Assignments, Tutorials, Mock Tests
PSO2	**Foundation of mathematical concepts:** Ability to apply the acquired knowledge of basic skills, principles of computing, mathematical foundations, algorithmic principles, modeling and design of computer- based systems in solving real world engineering Problems.	3	Lectures, Assignments, Tutorials, Mock Tests
PSO3	**Successful Career:** Ability to update knowledge continuously in the tools like Rational Rose, MATLAB, Argo UML, R Language and technologies like Storage, Computing, Communication to meet the industry requirements in creating innovative career paths for immediate employment and for higher studies.	2	Lectures, Assignments
1: Slight (Low)	**2: Moderate (Medium)**	**3: Substantial (High)**	**- : None**

VII. Syllabus:

UNIT - I

The Language of Logic: Propositions, Logical Equivalences, Quantifiers, Arguments, Proof Methods.

The Language of Sets: The Concepts of a Set, Operations with Sets, Computer Operations with Sets, The Cardinality of a Set, Recursively Defined Sets.

Functions: The concept of Functions, Special Functions, Properties of Functions, The Pigeonhole principle, Composite Functions, Sequences and the Summation Notation.

UNIT - II

Relations: Boolean Matrices, Relations and Digraphs, Computer Representations of Relations, Properties of Relations, Operations on Relations, Transitive Closure, Equivalence Relations, Partial and Total Ordering.

Lattices & Boolean Algebra: Lattices as Partially Ordered Sets, Properties of Lattices, Lattices as Algebraic Systems, Sublattices, Direct Product and Homomorphism, Boolean Algebra, Boolean Functions

UNIT - III

Algebraic Structures: Algebraic Systems, Semigroups and Monoids, Groups, Subgroups and Homomorphisms, Normal Subgroups.

Combinatorics: The Fundamental Counting Principles, Permutations, Derangements, Combinations, Permutations and Combinations with Repetitions, The Binomial Theorem, The Generalized Inclusion-Exclusion Principle.

UNIT - IV

Induction and Algorithms: The Division Algorithm, Divisibility Properties, Non decimal Bases, Mathematical Induction, Algorithm Correctness, The Growth Functions, Complexity of Algorithms.

Recursion: Recursively Defined Functions, Solving Recurrence Relations, Generating Functions, Recursive Algorithms, Correctness of Recursive Algorithms, Complexities of Recursive Algorithms.

UNIT - V

Graphs: Computer Representation of Graphs, Isomorphic Graphs, Paths, Cycles, and Circuits, Eulerian and Hamiltonial Graphs, Planar Graphs, Graph Coloring, Digraphs, DAGs, Weighted Digraphs, DFS and BFS Algorithms,Cut vertices and Edges,Covering,Matching.

Trees: Trees, Spanning Trees, Minimal Spanning Trees, Kruskal's and Prim's Algorithm, Rooted Trees..

Text Books:

1. Discrete Mathematical Structures with Applications to Computer Science, J.P. Tremblay, R. Manohar, McGraw Hill education (India) Private Limited. (UNITS - I, II)
2. Discrete Mathematics for Computer Scientists & Mathematicians, Joe L. Mott, Abraham Kandel, Theodore P. Baker, Pearson , 2nd ed. (Units - III, IV, V)

Reference Books:

1. Discrete Mathematics and its Applications, Kenneth H. Rosen, 7th Edition, McGraw Hill education (India) Private Limited.
2. Discrete Mathematics, D.S. Malik & M.K. Sen, Revised edition Cengage Learning.
3. Elements of Discrete Mathematics, C. L. Liu and D. P. Mohapatra, 4th edition, McGraw Hill education (India) Private Limited.
4. Discrete Mathematics with Applications, Thomas Koshy, Elsevier.
5. Discrete and Combinatorial Mathematics, R. P. Grimaldi, Pearson.

IX. Course Plan:

The course plan is meant as a guideline. There may probably be changes.

S.L.No	Topic Covered	Number of Period's	Outcomes	References
UNIT-I				
1	Introduction to discrete mathematics,statements,propositions,navigations,conjunction,disjunction,and its truth tables, conditions,bi-conditions and inverse, converce and contropositive, tautology, contradiction, logical equivalences and its laws of logic.	2	These topic are useful to design for logical program am	T: 1-31 R1: 45-87

2	Quantifiers(predicates, free and bound variables) Arguments(Rules of inference)Implications and equivalences with working examples	2	These are helpful to reducing of number of steps	T: 32-37 R1: 88-105
3	Proof Methods(Indirect method ,proof by contradiction)Automatic theorem proving	2	It concludes that of a theorem along with the statements of other premises is proved with contradiction.	T: 49-55 R2: 41-55
4	Normal forms(cnf,dnf,pcnf,pdnf)	2	A relation R is in first normal form (1NF) if and only if all underlying domains contain atomic values only.	T: 56-64 R3: 60-79
5	Set theory, types of sets, operations with sets, Cardinality of a set, Recursively defined sets	2	Bit string method can be used to represent sets in the computer by storing their elements in an ordered manner	T: 67-115 R1: 125-179
6	Functions and its types, composite functions invertible functions with working examples	2	The knowledge of functions is very useful both in mathematics and computer science.	T: 117-163 R2: 158-167
7	Special functions, pigeonhole principle(with examples)	1	It gives the utilization of the no of pigeons.	T: 64-175 R2: 176-189
UNIT-II				
8	Introduction to relations, properties of relations with worked examples	1	the knowledge of binary relation may be used to formalized a relationship between people, numbers, sets,….	T: 437-439 R2: 104-131 R1: 257-281
9	Matrix relations, di-graphs of relations, partial ordering relations and total ordering relations, hasse diagram with working examples	2	Output the information on the Relationship Matrix to the printer or to a metafile, .png file or .csv file	T: 439-454 R2: 137-157
10	Sum rule, product rule ,permutations ,permutation with repeat ions with working examples	2	it gives the sum value and product value along with gates, permutations gives the clear about the arrangements of products.	T: 461-475 R1: 3-15
11	Binomial theorem and multinomial theorem ,inclusion-exclusion principles with their working examples	2	the binomial theorem to help us expand binomials to any given power without direct multiplication	T: 482-493 R1: 16-37
UNIT-III				
12	Algebraic structures, binary, n-array operations ,group with worked examples	2	recognize certain well known groups ,rings and field structures.	T: 803-813 R1: 759-771
13	The Binomoal Theorem	2	the binomial theorem to help us expand binomials to any given power	T: 386-398 R1: 16-27

14	The fumdamental counting principle,permutations	2	it satisfies the property of relations and developed related values.	T: 343-363 R2: 234-236
15	Permutations ans combinations with repetations,Generalized Inclusion	1	it satisfies the property of relations and developed related values	T: 375-399 R2: 237-251
UNIT-IV				
16	Introduction to Algorithms,The Division Algorithm,Divisibility properties,Non Decimal Base	2	A generating function of a real-valued random variable is an expected value of a certain transformation of the random variable involving another (deterministic) variable	T: 185-196 R2: 19-62
17	Mathemathical Induction,Algorithm correctness,The growth functions,The growth functions,complexity of Algorithms	3	A recurrence relation is an equation that recursively defi nes a sequence or multidimensional array of values, once one or more initial terms are given: each further term of the sequence or array is defined as a function of the preceding terms.	T: 206-247 R2: 64-103
18	Recursively Defined Functions,Solving Recurrence relations	2	It develops the steps for generating functions in relations.	T: 261-278 R3: 265-280
19	Generating functions with their sequences ,finding the coefficients for generating functions	2	Approximately coefficient terms are getting and forms generating functions.	T: 298-306 R3: 237-247
20	Recursively defined functions, mathematical induction principles	2	it is an deductive in nature, it is usually employed in proving the validity of a statement involving all positive integer values of the number n.	T: 261-278 R3: 248-264
UNIT-V				
21	Graphs and its types with working examples ,complete graph, Directed graph, in degree and out degree ,computer representation of graphs(adjacencies matrix list)	3	it is to develop analyze problems of combinatorial nature that arise in computer science, research, economics.	T: 515-538 R1: 539-558
22	Isomorphism, connected graph ,walk, path circuits ,cycles ,Hamiltonian cycle and Hamiltonian path	2	Generating various cycles and walks through all the paths in between of the nodes.	T: 541-545 R3: 437-452
23	Euler circuits ,Euler paths, bipartite graph, complete bi-partite graph ,planar graph, non-planar graph, graph coloring	2	It converts the all adjustable cycles and provides coloring for graph.	T: 556-576 R1: 559-601
24	Trees, binary tree, rooted tree ,complete binary tree ,spanning tree ,BFS,DFS	2	bfs is helpful to search deeply and roots are connected for design to tree.	T: 609-613 R1: 619-667

X. Mapping course outcomes leading to the achievement of the programme outcomes:

Course Outcomes	Program Outcomes												
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**m**
1													H
2	S								H				
3			S										S
4					S								
5									S		H		S
6		H											

S = Supportive **H = Highly Related**

Justification of Course syllabus covering Course Outcomes:

By covering the syllabus a student can understand how to solve problems logically and its provide a prerequisite for the courses like Fundamentals of Computer Organization, RDBMS, Analysis of Algorithms, Theory of Computation, Cryptography, Artificial Intelligence

Justification of CO's –PO's Mapping Table:

By mapping CO-1 to the PO's M which are related to the course CO1: The student is able to balance the complexity of the problem.

By mapping CO-2 to the PO's A&I, which are related to the course CO2: The student is able to accuracy of the mathematical.

By mapping CO-3 to the PO's S & M which are related to the course CO3: The student is able to communicate both technical and non-technical material in a range of forms

By mapping CO-4 to the PO's E which are related to the course CO4: The student is able to • locate and use data and information and evaluate its quality with respect to its authority and relevance.

By mapping CO-5 to the PO'sI, K & M which are related to the course CO5: The student is able to understand constructively engage with other team members and resolve conflict.

By mapping CO-6 to the PO's B which are related to the course CO6: The student is able to understand contribute to professional work settings through effective participation in teams and organisation of project tasks.

Faculty **HCSED**