SREENIVASA INSTITUTE OF TECHNOGY AND MANAGEMENT STUDIES

(AUTONOMOUS)

Murukambattu, Chittoor

MCA DEPARTMENT

QUESTION BANK

For

24MCA111 - MATHEMATICAL FOUNDATIONS OF COMPUTER SCIENCE

Regulation – R24

Academic Year 2025 – 26

Prepared by

Mr. N. P. Gangadhar, Assistant Professor

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SUBJECT NAME : Mathematical Foundations of Computer Science **SUBJECT CODE : 24MCA111**

YEAR & SEM : I &I **Academic Year : 2025-26**

UNIT I - Mathematical Logic	
Statements and Notations - Connectives(Negation, Conjunction, Disjunction, Conditional and Bi-conditional Statements Formulas and Truth Tables - Well-Formed Formulas, Tautologies - Equivalence of Formulas - Duality Law - Tautological Implications - Normal Forms(DNF, CNF) - Theory of Inference for Statement Calculus: Validity using Truth tables - Rules of Inference - Consistency of Premises and Indirect Method of Proof.	
PART –A	
Q.No.	**Questions**
1	Define Statement.
2	Differentiate Atomic and Compound statement.
3	List the Logical operators.
4	Define Tautology
5	Define Contradiction.
6	Define Logical equivalence of two statement formulas.
7	Define Modus Tollen’s law in Inference.
8	Define Modus Ponens law in Inference.
9	Define Disjunctive Normal Form.
10	Define Principal Conjunctive Normal Form
11	Translate the following statement into symbolic form: “the crop will be destroyed if there is a flood”.
12	Find the Converse, Inverse and Contrapositive of the statement $P \rightarrow Q$.
13	Define Duality law in statement formula.
14	Find the number of rows in a Truth table if there are n number of variables in the Statement formula.
15	What is Logic.
PART-B	
16	Show that the following statement formulas are Tautologies. a) $((\neg Q) \wedge (P \rightarrow Q)) \rightarrow \neg(\neg P)$ b) $(P \rightarrow (Q \rightarrow R)) \rightarrow ((P \rightarrow Q) \rightarrow (P \rightarrow R))$
17	Show that the following equivalences a) $P \rightarrow (Q \rightarrow P) \Leftrightarrow (\neg P \rightarrow (P \rightarrow Q))$ $P \rightarrow (Q \vee R) \Leftrightarrow (P \rightarrow Q) \vee (P \rightarrow R)$
18	Show that the following equivalences without constructing Truth table a) $(((P \vee \neg P) \rightarrow Q) \rightarrow ((P \vee \neg P) \rightarrow R)) \Leftrightarrow Q \rightarrow R$ $(\neg P \wedge (\neg Q \wedge R)) \vee (Q \wedge R) \vee (P \wedge R) \Leftrightarrow R$
19	Obtain the Conjunctive Normal form of a) $(\neg P \rightarrow R) \wedge (Q \leftrightarrow P)$ $P \rightarrow ((P \rightarrow Q) \wedge \neg(\neg P \vee \neg Q))$
20	Obtain the Disjunctive Normal form of a) $(P \wedge Q) \vee (\neg P \wedge R) \vee (Q \wedge R)$ b) $P \rightarrow ((P \rightarrow Q) \wedge \neg(\neg P \vee \neg Q))$
21	Find the Disjunctive and Conjunctive normal form of the formula of $\neg(P \vee Q) \leftrightarrow (P \wedge Q)$
	Let P,Q and R be the propositions P: you have the flee Q: you miss the final examination R: you pass the

22	course. Write the following propositions into statement form. (i) P→Q (ii) ~P→R (iii) Q→~R (iv) P ∨Q ∨ R (v) (P→~R)∨(Q→~R)
23	Show that S ∨ R is a tautologically implied by (P ∨ Q)Λ (P→ R) Λ (Q→ S) With reference to rules of inference.
24	Show that a) R ∧ (P ∨ Q) is a valid conclusion from the premises P ∨ Q, Q→ R, P→ M and ┐M R is a valid Inference from the premises P→ Q, Q→ R and P.
25	Show that the following system is inconsistent. (P→Q), (P→R), (Q→┐R), P
26	Using the statements R: Mark is rich, H: Mark is happy Write the following statements in symbolic form a) Mark is poor but happy. b) Mark is rich or unhappy. c) Mark is neither rich nor happy. d) Mark is poor or he is both rich and unhappy. Mark is rich and happy.
27	Explain about the Logical connectives with an example.
28	Construct the Truth table of the following statement formula a) (P ∧ Q) → ┐(P ∨Q) ↔ (P ∧Q) b) (P → (Q → R)) → ((P → Q) →(P→R))
29	Discuss about Rules of Inference in Statement calculus.
30	Show that the following statement formulas a) (P ∧ (┐P ∧ Q) is a Contradiction. b)(P ∨ Q) ∧ (P→Q) is a Contingency.
UNIT II - Predicate Calculus	
Predicates - The Statement Function - Variables - Quantifiers - Predicate Formulas - Free and Bound Variables - The Universe of Discourse - Theory of Inference for Predicate Calculus: Valid Formulas and Equivalences - Some Valid Formulas over Finite Universes - Special Valid Formulas Involving Quantifiers.	
PART –A	
31	Define Predicate logic.
32	Identify the Predicate and Object name in the following statements (i) Rama is a bachelor. (ii) Govind is a bachelor.
33	Give an example for 3-place predicate statement.
34	Define simple statement function.
35	Find when a statement function becomes a statement.
36	Distinguish Bound and Free variable with an example.
37	Translate the following statement into symbolic form: All men are mortal No men are mortal.
38	Define Quantified statement.

39	Define the Equivalence of Two Predicate statement formulas.
40	Define Universal Quantifier.
41	Define Existential Quantifier.
42	Define a valid Predicate statement formula.
43	State rules for Negation of a Quantified statement.
44	Define Universal Specification rule.
45	Define Existential Generalization.
	PART –B
46	Symbolize the following Predicate statements a) Vivekanandan is taller than Srinivasan. b) all human beings are Mortal. c) Someone in your college has visited Tirumala. d) some Indians are affected by Covid-19. Rama is a Bachelor.
47	Write each of the following in symbolic form i) all monkeys have tails ii) no monkey have tail iii) some monkey have tails iv) some monkey have no tails v) there exists a man. all dogs are animals
48	For the Universe of all integers, Let $P(x) : x > 0$, $Q(x)$: x is even $R(x)$: x is a perfect square, $S(x)$: x is divisible by 3 $T(x)$: x is divisible by 7 Write the following quantified statements in symbolic form. a) Atleast one integer is even. b) There exist a positive integer that is even. c) Every integer is even. d) If x is even and a perfect square then x is not divisible by 3. If x is odd or is not divisible by 7 then x is divisible by 3.
49	Express each of the following symbolic statements in words i) $\forall x, [R(x) \rightarrow P(x)]$ ii) $\exists x, [S(x) \rightarrow \neg Q(x)]$ iii) $\forall x, [\neg R(x)]$ $\forall x, [R(x) \vee T(x)]$
50	Find the Truth value of the following Quantified statement $\vee x, P(x)$ and $\exists x, P(x)$, where $P(x)$: x is greater than 2 and the Universe of discourse is stated as a) { -5, -3, 0, 1, 2} b) {3,5,7,10} {-1,0,2,6}
51	Discuss about Statement function, Variables and Quantifiers with suitable example.
52	a) Consider the statement "Given any positive integer there is a greater positive integer". Symbolize this statement by using set of positive integers as the Universe of discourse. Symbolize the statement "x is the father of the mother of y".
53	Discuss about the Rules of Inference for Predicate calculus Discuss about the Negation rule in Quantified statement and Equivalence in Predicate statement.
	UNIT- III - Relations & Functions

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Relations: Properties of Binary Relations, Equivalence - Closure of Relations - Compatibility and Partial Ordering Relations - Hasse Diagram . Functions: Inverse function - Composition of Functions - Recursive Functions - Pigeon Hole Principles and its Applications.	
PART – A	
54	Define relation.
55	List the properties of binary relation in a set.
56	Define Compatibility relation.
57	Define Equivalence relation.
58	Distinguish between compatibility relation and Equivalence relation.
59	Define Po-set.
60	What is a Hasse diagram.
61	Draw Hasse diagram for divisibility on the set {1,2,3,4}
62	List all the ordered pairs in the relation R = {(a,b) / a divides b} on the set A = {1,2,3,4}
63	Define Equivalence class.
64	Define function.
65	Define one-to-one function.
66	Define Initial functions.
67	Define Partial recursive function.
68	Define Lattice.
PART –B	
69	Explain the properties of binary relation in a set with suitable example.
70	Let X = {1,2,3,4,5,6,7} and R = { (x,y) / x-y is divisible by 3}. Show that R is an equivalence relation and also draw the graph of R.
71	Let Z be the set of integers and let R be the relation called Congruence modulo 3. Determine the equivalence class generated by the elements of Z.
72	Draw the Hasse diagram for divisibility on the following sets a) {1,2,3,4,6,8,12} {1,2,3,6,12,24,36,48}
73	a) If A=Z ,the set of integers, Define R= {(a, b)/ a divides b}. Test whether R is a Partial order relation or not. (5 M) Suppose the function f is defined recursively by f(0)=1, and f(x+1) = 3 f(x)+1. Compute f (1), f(2) and f(3).
74	Let f: $R^+ \rightarrow R^+$ given by $f(x) = x^2$. Show that f is invertible.
75	Find the inverse of the following functions a) $f(x) = x^3+1$ f(x) = (x-2)/(x-3)
76	Show that the function f(x, y) = x + y is primitive recursive.
77	a) Discuss about a method of finding maximal compatibility block. b) Let X = {1,2,3} and f, g, h and s be functions from X to X given by f = {(1,2),(2,3),(3,1)}, g = {(1,2),(2,1),(3,3)}, h = {(1,1),(2,2),(3,1)}, s = {(1,1),(2,2),(3,3)} Find fog, gof, fohog, sog, gos, sos, and fos.
78	If A denotes Ackermann's function, Evaluate A(1,1), A(1,2), A(2,2), A(1,3), A(1,4)

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UNIT IV - Algebraic Structures

Algebraic Systems - Examples and General Properties - Semi Groups - Monoids - Groups and Subgroups - Homomorphism and Isomorphism.

PART – A

79	Define algebraic system.
80	Determine whether the algebraic system (N,+,X) satisfies the Inverse property w.r.t to operatin.
81	Define homomorphism between algebraic systems.
82	Define Semi group.
83	Define Monoid.
84	Determine whether (N,+) is Monoid or not.
85	Give an example for subsemigroup
86	Define Group.
87	Define Order of a Group.
88	Define Subgroup of a Group.

PART –B

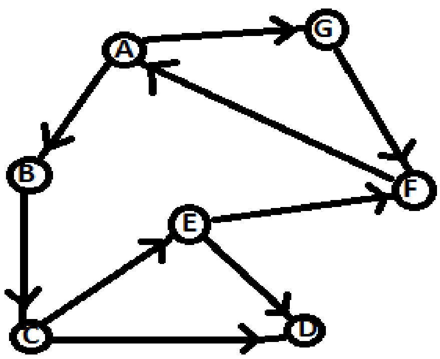
89	Explain algebraic system and important properties with an example.
90	Let (N,+) and (Z_4, $+_4$) are algebraic systems, show that there exists a homomorphism from (N,+) to (Z_4, $+_4$).
91	Show that the algebraic systems (N, +) and (N, X) are monoids, where N is the set of natural numbers.
92	Show that the algebraic systems (E, +) and (E, X) are semigroups, where E is the set of positive even numbers.
93	Let Q be the set of rational numbers and the operation * is defined by a*b = a+b-ab. Show that under *operation, Q forms a commutative monoid.
94	Show that His a sub group of G iff for every a,b ϵ H then ab ϵH and a^{-1} ϵ H
95	Prove that in a Group , there exists only one Identity element . or the Identity element in a group is Unique.
96	Explain Group and Subgroup with suitable example.
97	Let G be the set of all non-zero real numbers and let a*b = (½)(ab). Show that (G,*) is an abelian group.
98	Prove that a group is abelian iff $(ab)^{-1} = a^{-1}b^{-1}$

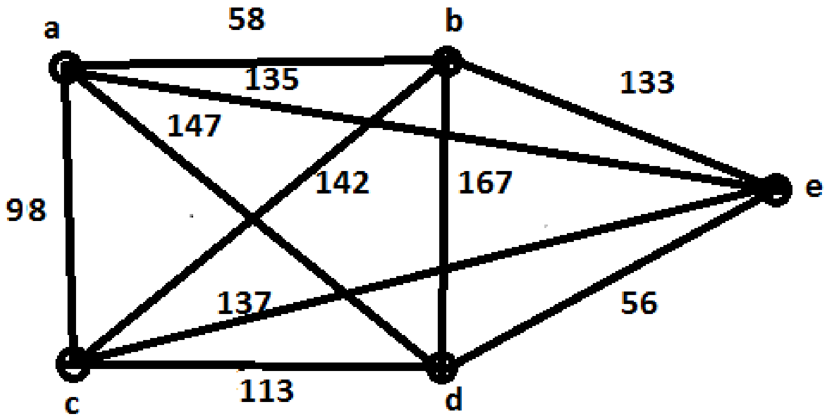
UNIT V - Graph Theory

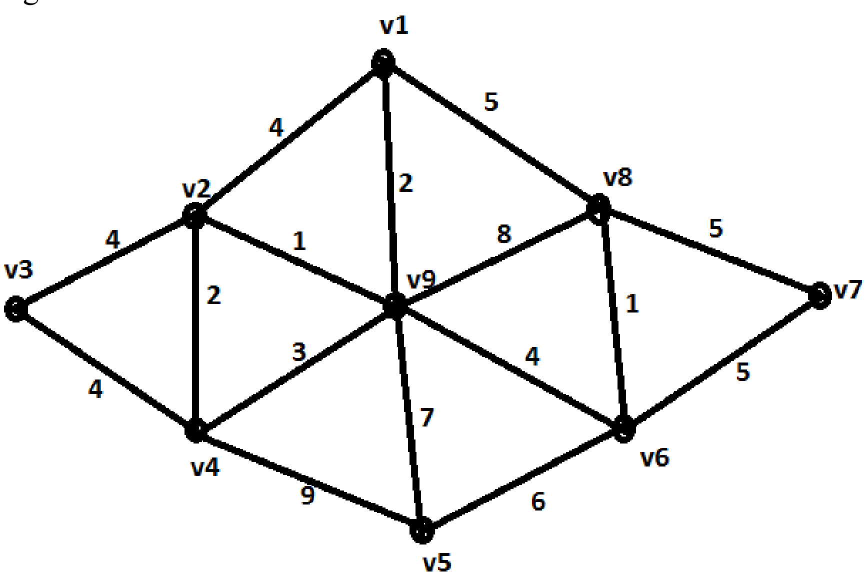
Basic Terminology - Multi Graphs - Weighted Graphs - Digraphs and Relations - Representations of Graphs (Incidence Matrix, Adjacency Matrix) - Operations on Graphs - Isomorphism and Sub Graphs. Paths and Circuits - Graph Traversals(DFS, BFS) - Shortest Paths in Weighted Graphs - Eulerian Paths and Circuits - Hamiltonian Paths and Circuits - Planar Graph - Graph Coloring - Spanning Trees - Minimum Spanning Trees - Kruskal’s Algorithm - Prim’s Algorithm.

PART – A

99	Define complete graph.
100	Distinguish between directed graph and undirected graph.
101	Define weighted graph.

102	Define adjacency matrix of a graph.
103	Compare spanning subgraph and subgraph.
104	Define graph traversal.
105	List the algorithms for graph traversal.
106	List the operations on graphs.
107	Define Planar graph.
108	Define Euler circuit.
109	Define graph coloring.
110	Define minimum spanning tree.
111	List the algorithms used to find minimum spanning tree.
112	Draw a Complete Bipartite graph $K_{3,4}$.
113	Distinguish between Multi graph and Mixed graph.
	PART –B
114	Give an example for the each of the following graph a) Simple graph b) complete graph c) Bi-partite graph d) Mixed graph Multi graph
115	Explain representation of Graphs with a suitable example.
116	a) Discuss about Di-graphs and Relations. Discuss about Isomorphic graphs.
117	Discuss about Operations on graphs with an example.
118	Explain Graph Traversals algorithms with an example.
119	Apply Depth-First Search and Breadth-First Search algorithm to the following graph. 

120	Solve the Traveling sales person problem for the weighted graph given in figure using nearest neighbor method. 
121	Discuss about Planar graph and Eulearian graph.

122	Find the Minimum Spanning tree using Kruskal’s algorithm of the weighted graph G given in figure. 

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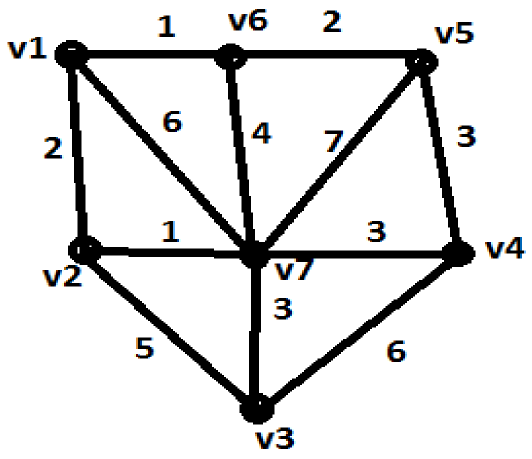
123	Find the Minimum Spanning tree using Prim's algorithm to the following weighted connected graph 
124	Explain Kruskal's algorithm with suitable example.
125	Explain Prim's algorithm with suitable example.