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Course Code: MCA-101 **Course Name: Discrete Structures**

Practice Questions (Theory)

	UNIT– I
Q1.	Design a set that contains the prime numbers less than 10.
Q2.	Construct a Venn diagram to illustrate the relationship between three sets A, B, and C.
Q3.	Prove that for any sets A, B, and C, $(A \cap B) \cup (A \cap C) = A \cap (B \cup C)$.
Q4.	Solve the equation $\|x - 3\| = 5$ and express the solution set in set-builder notation.
Q5.	Develop a relation on the set of integers that is both symmetric and transitive but not reflexive.
Q6.	Determine whether the relation R = {(1, 2), (2, 3), (3, 4)} is an equivalence relation, and if not, modify it to become one.
Q7.	Evaluate the equivalence class [2] in the relation R = {(1, 2), (2, 3), (3, 4)}.
Q8.	Solve the inequality x^2 + y^2 ≤ 25 and express the solution set as a relation.
Q9.	Create a function f(x) such that f(f(x)) = x for all real numbers x.
Q10.	Determine the range of the function f(x) = 2x^2 - 3x + 1.
Q11.	Solve the functional equation f(x + y) = f(x) + f(y) for the function f(x) = ax + b.
Q12.	Find the inverse function of f(x) = 3x + 5.
Q13.	Prove the sum of the first n odd numbers is n^2 using mathematical induction.
Q14.	Use mathematical induction to prove the inequality n! > 2^n for all positive integers n ≥ 4.
Q15.	Prove the statement: For all positive integers n, 3^n > n^2 using mathematical induction.
Q16.	Show that 6^n - 1 is divisible by 5 for all positive integers n using mathematical induction.
Q17.	Determine the number of permutations of the word "MATH" and list them.
Q18.	Find the number of ways to arrange 5 books on a shelf if 2 specific books must be next to each other.
Q19.	Solve the permutation problem: In how many ways can 5 students be seated in a row if 2 of them insist on sitting next to each other?
Q20.	Calculate the number of permutations of the word "MISSISSIPPI."
Q21.	Determine the number of combinations of 5 items taken 3 at a time.
Q22.	Find the number of ways to select a committee of 4 people from a group of 8 if 2 members must be female.
Q23.	Solve the combination problem: In how many ways can 5 books be chosen from a shelf of 10 books?
Q24.	Calculate the number of combinations of 6 items taken 2 at a time.
	UNIT II

Q25.	Formulate a truth table for the logical expression $(p \wedge q) \vee (\sim p \wedge r)$.
Q26.	Prove the logical equivalence: $\sim(p \vee q) \equiv (\sim p \wedge \sim q)$.
Q27.	Solve the logical equation: $(p \vee q) \wedge (\sim p \vee r) = r$.
Q28.	Determine whether the logical expression $p \Rightarrow (q \wedge r)$ is a tautology.
Q29.	Construct a Hasse diagram for the poset $(Z, \leq)$.
Q30.	Prove that the set of all subsets of a set forms a lattice under set inclusion.
Q31.	Determine the greatest lower bound and least upper bound for the poset $(P(\{1, 2, 3\}), \subseteq)$.
Q32.	Find the meet and join operations for the lattice (Z, gcd, lcm).
Q33.	Simplify the Boolean expression F(A, B, C) = A'B + AB' + AC.
	Simplify the Boolean expression F(A, B, C, D) = (A + B')(C' + D)(A' + B + D').
Q34.	Solve the Boolean equation AB + A'B = A + B.
Q35.	Minimize the Boolean function F(A, B, C) = Σ(0, 1, 3, 5, 6, 7).
Q36.	Find the minimal sum-of-products expression for the function F(A, B, C, D) = Σ(0, 1, 3, 5, 7, 8, 10, 12, 14, 15).
Q37.	Simplify the Boolean function F(A, B, C, D) = Σ(1, 3, 5, 7, 9, 11, 13, 15).
Q38.	Solve the K-map problem: Minimize the function F(A, B, C) = Σ(0, 1, 3, 5, 6, 7).
Q39.	Analyze the logical expression $\sim(p \wedge q) \vee (p \wedge r)$ to determine its truth values for different assignments to p, q, and r.
Q40.	Evaluate the logical expression $(p \wedge q) \Rightarrow (r \vee \sim q)$ when p is true, q is false, and r is true.
UNIT III	
Q41.	Define a group and provide an example.
Q42.	Prove that the set of integers under addition forms a group.
Q43.	Solve the equation x^3 = e in the group (Z, +), where e is the identity element.
Q44.	Determine whether the set of even integers forms a subgroup of the group of integers under addition.
Q45.	State and prove Fermat's Little Theorem.
Q46.	Calculate the multiplicative inverse of 17 modulo 31.
Q47.	Solve the linear congruence $3x \equiv 7 \pmod{11}$.
Q48.	Determine the greatest common divisor (GCD) of 72 and 120 using the Euclidean algorithm.
Q49.	Prove that the order of an element in a group divides the order of the group.
Q50.	Show that the set of rational numbers with addition forms an infinite cyclic group.
Q51.	Determine whether the group of invertible 2x2 matrices under matrix multiplication is abelian.
Q52.	Solve the equation x^2 = e in the group (Z/6Z, +), where e is the identity element.
Q53.	Calculate the Euler's totient function φ(35).
Q54.	Solve the system of congruences: $x \equiv 2 \pmod 3$ $x \equiv 3 \pmod 5$ $x \equiv 4 \pmod 7$
Q55.	Prove Lagrange's theorem for finite groups.
UNIT IV	
Q56.	Define a simple path and a circuit in a graph.
Q57.	Prove that if a graph has n vertices, the maximum number of edges in a path is n-1.
Q58.	Calculate the length of the shortest path between two vertices in a given weighted graph.
Q59.	Determine whether a given graph contains an Eulerian circuit or path.
Q60.	Explain Dijkstra's algorithm for finding the shortest path in a weighted graph.
Q61.	Describe Warshall's algorithm for finding the transitive closure of a directed graph.

Q62.	Compute the transitive closure of a given directed graph using Warshall's algorithm.
Q63.	Discuss the application of Warshall's algorithm in computing the reachability matrix.
Q64.	Define Prim's algorithm for finding the minimum spanning tree of a graph.
Q65.	Prove that Prim's algorithm always produces a minimum spanning tree.
Q66.	Find the minimum spanning tree of a given weighted graph using Prim's algorithm.
Q67.	Discuss the application of Prim's algorithm in network design and clustering.
Q68.	Explain Kruskal's algorithm for finding the minimum spanning tree of a graph.
Q69.	Analyze the time complexity of Kruskal's algorithm.
Q70.	Compute the minimum spanning tree of a given weighted graph using Kruskal's algorithm.
Q71.	Compare and contrast Prim's and Kruskal's algorithms for finding minimum spanning trees.
Q72.	Define a tree and its properties.
Q73.	Prove that a connected graph with n vertices and n-1 edges is a tree.

****************Wish you luck!*****************