

Roll No.

Total Pages : 3

MCA/D-19

10013

**DISCRETE MATHEMATICAL
STRUCTURES**

Paper-MCA-14-14

Time Allowed : 3 Hours

[Maximum Marks : 80

Note : Attempt five questions in all, selecting at least one question from each Unit. Question No. 1 is compulsory. All questions carry equal marks.

Compulsory Question

- (a) What are the techniques to represent set ?
(b) What is a Transitive relation ?
(c) Draw the truth table for Biconditional statement.
(d) State principle of Inclusion-exclusion.
(e) What is divide and conquer algorithm ?
(f) What are DeMorgan's laws ?
(g) Define the Graph.
(h) What is a Binary Search Tree ? 8×2=16

UNIT-I

- (a) When a function is said to be one-to-one, onto and invertible ? Let $A = \{a, b, c\}$, $B = \{x, y, z\}$, $C = \{r, s, t\}$. Let $f : A \rightarrow B$ and $g : B \rightarrow C$ be

defined by : $f = \{(a, y) (b, x), (c, y)\}$ and $g = \{(x, s), (y, t), (z, r)\}$. Find :

- (i) Composition function $g \circ f : A \rightarrow C$;
(ii) $\text{Im}(f)$, $\text{Im}(g \circ f)$, $\text{Im}(g \circ f)$. 8
- (b) What is an equivalence relation ? Let R be the relation on the set of real numbers such that aRb if and only if $a - b$ is an integer. Is R an equivalence relation ? 8
- (a) Explain the various set operations using suitable examples. 8
(b) Consider the set Z of integers. Define aRb by $b = a^r$ for some positive integer r . Show that R is a partial order on Z . 8

UNIT-II

- (a) Show that $\neg(p \vee (\neg p \wedge q))$ and $\neg p \wedge \neg q$ are logically equivalent by developing a series of logical equivalences. 8
(b) Describe the various rules of inference in brief. 8
- (a) Each user on a computer system has a password, which is six to eight characters long, where each character is an uppercase letter or a digit. Each password must contain at least one digit. How many possible passwords are there ? 8
(b) Prove that there are $C(n + r - 1, r) = C(n + r - 1, n - 1)$ r -combinations from a set with n elements when repetition of elements is allowed. 8

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UNIT-III

6. Let c_1 and c_2 be real numbers. Suppose that $r^2 - c_1 r - c_2 = 0$ has two distinct roots r_1 and r_2 . Then prove that the sequence $\{a_n\}$ is a solution of the recurrence relation $a_n = c_1 a_{n-1} + c_2 a_{n-2}$ if and only if $a_n = \alpha_1 r_1^n + \alpha_2 r_2^n$ for $n = 0, 1, 2, \dots$, where α_1 and α_2 are constants. 16
7. What is a Lattice ? Describe various axioms defining a lattice. What are the various types of lattices ? Explain in detail using suitable examples. 16

UNIT-IV

8. (a) Prove that a simple graph is bipartite if and only if it is possible to assign one of two different colors to each vertex of the graph so that no two adjacent vertices are assigned the same color. 8
- (b) What are the necessary and sufficient conditions for Euler's path and circuit ? 8
9. (a) Write and explain the Dijkstra's algorithm for finding the shortest path. 8
- (b) Write and explain Prim's algorithm for finding the minimum spanning tree. 8