

**P-874**

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Roll No. ....

# **MCS-501**

## **Discrete Mathematics**

Master of Computer Application (MCA)

3rd Semester Examination, 2023 (June)

**Time : 2 Hours]**

**[Max. Marks : 70**

**Note :** This paper is of Seventy (70) marks divided into two (02) Sections A and B. Attempt the questions contained in these sections according to the detailed instructions given therein. Candidates should limit their answer to the questions on the given answer sheet. No additional (B) answer sheet will be issued.

### **SECTION–A**

#### **(Long Answer Type Questions)**

**Note :** Section 'A' contains Five (05) long answer type questions of Nineteen (19) marks each. Learners are required to answer any Two (02) questions only.

(2×19=38)

1. (a) Define a relation. Let  $R$  be a relation on a set of ordered pairs of natural numbers, that is  $\mathbb{N} \times \mathbb{N}$ , defined as  $(a, b) R(c, d)$  iff  $a + d = b + c, \forall a, b, c, d \in \mathbb{N}$ . Prove that  $R$  is an equivalence relation. (10)
- (b) Define composition of functions. Let  $f$  and  $g$  be functions from the set of real numbers to the set of real numbers defined by  $f(x) = \sqrt{x}$  and  $g(x) = x - 3$ , then check whether  $f \circ g(x)$  and  $g \circ f(x)$  exist? If so, then find them. (9)
2. (a) Define logical equivalence. Prove that  $P \rightarrow Q \equiv \sim Q \rightarrow \sim P$ . (10)
- (b) Write predicates for the following sentences: (9)
- All boys are tall.
  - Some politicians are clever.
  - Some students are not regular.
3. (a) Define principle of mathematical induction. Using mathematical induction prove that for every positive integer  $n \geq 4, 2^n < n!$ . (10)
- (b) Solve the recurrence relation  $a_r - 7a_{r-1} + 12a_{r-2} = r2^r$ . (9)
4. (a) Define generating function. Find the generating function of the following series 2, 4, 8, 16, 32,... (10)

(b) Define a sub group. Prove that A non-empty subset H of a group G is a subgroup of G if  $a \in H, b \in H \Rightarrow ab^{-1} \in H$ . (9)

5. (a) Define Mealy and Moore machines with the help of suitable examples. (10)
- (b) Define Hamiltonian and Euler graphs with the help of suitable examples. (9)

## SECTION-B

### (Short Answer Type Questions)

**Note :** Section 'B' contains Eight (08) short answer type questions of Eight (08) marks each. Learners are required to answer any Four (04) questions only. (4×8=32)

1. Define the followings with the help of suitable examples :
- (a) Cartesian product of two sets.
- (b) Matrix of a relation.
2. Define one-one and onto functions with the help of suitable examples.
3. Define tautology and contradiction with the help of suitable examples.

4. Explain Inclusion -Exclusion principle. Three problems A, B , and C have been given to a class of 80 students. It is found that 30 students solved A, 40 solved B, 50 solved C, 20 solved both A and B, 25 solved both B and C, 15 solved both A and C, and 10 students solved all three problems. Find the number of students who did not solve any problem.
  5. Define a ring with the help of a suitable example.
  6. Define connected graph, disconnected graph and components with the help of suitable examples.
  7. Define deterministic finite automaton. Let  $\Sigma = \{a, b\}$ , then design a DFA that accepts all the strings that starts with *aba*.
  8. Define a Tree. Prove that there is one and only one path between every pair of vertices in a tree T.
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