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Paper Code : BCAC201 Discrete Structures

UPID : 200050

Time Allotted : 3 Hours

Full Marks : 70

The Figures in the margin indicate full marks.

Candidate are required to give their answers in their own words as far as practicable

Group-A (Very Short Answer Type Question)

1. Answer any ten of the following :

[1 x 10 = 10]

- (I) Define a ring with an example.
- (II) What is an undirected graph?
- (III) What does the power set of a set contain?
- (IV) Define modus ponens.
- (V) Define permutations and combinations and provide a brief difference between them.
- (VI) Define a field and provide an example.
- (VII) Define the degree of a vertex in a graph.
- (VIII) What is the pigeonhole principle?
- (IX) Explain the difference between universal and existential quantification in predicate logic.
- (X) Define a closed-form expression and explain its significance in solving combinatorial problems.
- (XI) Define semigroup and explain its main property.
- (XII) Define the adjacency matrix of a graph.

Group-B (Short Answer Type Question)

Answer any three of the following :

[5 x 3 = 15]

2. Explain the difference between a one-to-one function and an onto function with examples. [5]
3. How many ways are there to arrange the letters in the word "COMBINATORICS"? [5]
4. Prove that fourth roots of unity form a cyclic group with respect to multiplication operation. [5]
5. What is a cycle in a graph? How does it differ from a simple path? [5]
6. Convert the proposition "(p and q) or r" into conjunctive normal form (CNF). [5]
Provide the disjunctive normal form (DNF) for the proposition "(p → q) and (q → r)".

Group-C (Long Answer Type Question)

Answer any three of the following :

[15 x 3 = 45]

7. (a) Explain the concept of degree in a graph with examples. [12]
What is a path in a graph? Describe the types of paths.
Explain the concept of connectivity in a graph with examples.
- (b) Discuss the applications of graphs in real-life scenarios. [3]
8. (a) Define a permutation group and provide an example. [10]
Prove that every permutation group is a subgroup of the symmetric group.
- (b) Define what a cyclic group is and provide an example. [5]
9. Discuss the concepts of validity, predicate logic, and universal and existential quantification in predicate logic. Provide examples to illustrate each concept. [15]
10. (a) Use induction to prove that [5]
 $n^2 < 2^n$
for all positive integers $n \geq 5$.
- (b) How many permutations are there of the letters in the word "APPLE"? [5+5]
How many different arrangements can be made from the digits 1, 2, 3, 4, 5 without repetition?
11. (a) There are 100 students in a Student Activity Club of which 35 like drawing and 45 like music. 10 students are interested in both drawing and music. Find the number of students that like either of them or neither of them. [7]
- (b) If $S = \{a, e, i, o, u\}$ and [5]

$A = \{a, e, i\}$

$B = \{e, o, u\}$

$C = \{a, i, u\}$

Verify whether the value is true or not: $A \cap (B - C) = (A \cap B) - (A \cap C)$.

(c) Set $S = \{5, 10, 15, 20, 25, 30\}$ is given in the roster form. Rewrite it in,

[3]

(i) Set Builder Form

(ii) Semantic Form

*** END OF PAPER ***