

A-1145

Total Pages : 7

Roll No.

BCA(N)-204

Discrete Mathematics

Examination, June 2025

Time : 2:00 Hrs.

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 answers to the questions on the given answer sheet. No additional (B) answer sheet will be issued.*

Section-A

Long Answer Type Questions 2×19=38

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.

1. (a) Define and explain the following types of sets with suitable examples :
 - (i) Null set
 - (ii) Subset
 - (iii) Power set
 - (b) Define Cartesian product. Let $A = (1, 2)$ and $B = (a, b, c)$. Find $A \times B$ and $B \times A$. Is $A \times B = B \times A$? Justify your answer.
 - (c) Given the set $A = \{1, 2, 3\}$, define a relation $R = \{(1, 1), (2, 2), (3, 3), (1, 2), (2, 3)\}$ on A . Check whether R is reflexive, symmetric, transitive, or anti symmetric.
 - (d) Explain the matrix and arrow diagram representation of a relation with examples.
2. (a) Define inference and explain the following with suitable examples :
 - (i) Modus Ponens
 - (ii) Modus Tollens
 - (b) Define Universal and Existential Quantifiers with suitable examples.
 - (c) Consider the implication : "If it rains, then the ground is wet". Write its converse, inverse, and contrapositive.

- (d) Use truth tables to determine whether the given statement is a tautology or not.

$$(p \wedge q) \leftrightarrow (\neg q \vee \neg p)$$

3. (a) Define permutations and combinations with example.
- (b) Solve the following problem using the inclusion-exclusion principle :

In a class of 50 students, 30 like Math, 25 like Physics, and 20 like both. How many students like neither Math nor Physics ?

- (c) Prove using mathematical induction that :

$$1 + 2 + 3 + \dots + n = \frac{n(n+1)}{2}$$

- (d) Define a recurrence relation. What are its order and degree ?
4. (a) Define a generating function. What is the significance of generating functions in solving recurrence relations ?
- (b) Define a binary composition and explain the closure, associative, identity, inverse, and commutative properties with suitable examples.

- (c) Distinguish between semi-group, monoid, and group with examples.
 - (d) Define a cyclic group and permutation Group.
5. (a) Define the following with examples :
- (i) Multi-Graph
 - (ii) Complete Graph
 - (iii) Regular Graph
 - (iv) Bipartite Graph
 - (v) Null Graph
- (b) What is tree ? Define the following types of trees :
- (i) Rooted tree
 - (ii) Binary tree
 - (iii) Binary search tree
- (c) Explain the Chomsky Hierarchy of grammars with examples.

Section–B

Short Answer Type Questions 4×8=32

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.

1. (a) Define a function. Explain following types of functions with examples :
 - (i) Into
 - (ii) Onto
 - (iii) Many-one into
- (b) What is a recursively defined function ? Define with an example.
2. (a) Test the validity of the following argument using a truth table :

Premises:

$$p \rightarrow q$$
$$q \rightarrow r$$
$$\neg r$$

Conclusion : $\neg p$
- (b) Define Principal Conjunctive Normal Form (PCNF) with example.
3. (a) Convert the following statements into predicate logic :
 - (i) All humans are mortal.
 - (ii) Some students are intelligent.
 - (iii) All birds can fly.
 - (iv) Every computer has a processor.

- (b) Define the Sum Rule in combinatorics with suitable examples.
4. (a) Solve the following recurrence relation :
- $$a_n = 2a_{n-1} + 3^n, \text{ with } a_0 = 0$$
- (b) A committee of 4 is to be formed from 6 men and 4 women. How many ways can this be done :
- (i) Without any restriction
- (ii) With exactly 2 women
5. (a) Define a coset ? Give examples and explain how cosets partition a group.
- (b) Define the centralizer and normalizer of an element in a group. Give suitable examples of both.
6. (a) Define the following with examples :
- (i) Directed graph
- (ii) Undirected graph
- (iii) Weighted graph
- (b) Draw and explain the complete graph K_4 . State how many edges a complete graph with n vertices has.
7. (a) What is the difference between a tree and a graph ? Give an example of each.

- (b) Define Tree Traversal and also explain preorder and postorder traversal of a binary tree.
- 8. (a) Define Alphabet, Word, and Language in the context of automata theory.
- (b) What is a Deterministic Finite Automaton (DFA) ? Define its components.
