



'সমানো মন্ত্র: সপিতি: সমানী'

**UNIVERSITY OF NORTH BENGAL**  
B.Sc. Honours 2nd Semester Examination, 2023

**CC4-COMPUTER SCIENCE (23)**  
**DISCRETE STRUCTURES**

Time Allotted: 2 Hours

Full Marks: 60

*The figures in the margin indicate full marks.  
Answer all questions with internal choices.*

**GROUP-A**

**Answer any four questions**

3×4 = 12

1. Define tautology, contradiction and satisfiable with an example.
2. Represent the statement "It is raining and I will not go to college" using propositional logic.
3. Prove that in a graph the number of vertices of odd degree is always even.
4. Find the generating function for the sequence {0, 0, 1, 1, 1 .....}.
5. A committee of 7 members is to be chosen from 6 artists, 4 singers and 5 writers. In how many ways can this be done if in the committee there must be at least one member from each group and at least 3 artists?
6. Prove using Venn diagram that:  $(B - A) \cup (C - A) = (B \cup C) - A$ .

**GROUP-B**

**Answer any four questions**

6×4 = 24

7. Prove the following logical argument: If horses fly or cows eat grass, then the mosquito is the national bird. If the mosquito is the national bird then peanut butter tastes good on hot dogs. But peanut butter tastes terrible on hot dogs. Therefore, cows don't eat grass.
8. A new flag is to be designed for your college; it should have 6 vertical strips using four colors. In how many ways can this be done such that no two adjacent strips should have the same color?
9. Solve the recurrence relation:  $a_n = a_{n-1} + 2a_{n-2}$  with  $a_0 = 2$  and  $a_1 = 7$ .
10. Let  $f : A \rightarrow B$  and  $g : B \rightarrow C$  be bijective then show that  $(g \circ f)^{-1} = f^{-1} \circ g^{-1}$ .
11. Prove using mathematical induction  $1^2 + 2^2 + 3^2 + \dots + n^2 = \frac{n(n+1)(2n+1)}{6}$ .
12. Explain the steps to determine the planarity of a graph.

## GROUP-C

Answer any *two* questions

12×2 = 24

13. Prove using mathematical induction:

$$1 + 4 + 7 + \dots + (3n - 2) = \frac{n(3n - 1)}{2}, n \in N$$

14. If  $f : Z \times Z \rightarrow Z$ , where  $Z$  is the set of integers and  $f(x, y) = x * y = x + y - xy$ .

Prove that the binary operation  $*$  is commutative and associative, also find the identity element and inverse of each element.

15. Prove that in a simple graph with  $n$  vertices and  $k$  components can have utmost  $(n - k)(n - k + 1)/2$  edges.

16. Prove using propositional logic:

$$(i) (p \rightarrow r) \vee (q \rightarrow r) \equiv (p \wedge q) \rightarrow r$$

$$(ii) p \leftrightarrow q \equiv (p \wedge q) \vee (\neg p \wedge \neg q).$$

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