UNIVERSITY OF NORTH BENGAL
BCA Honours 3rd Semester Examination, 2023

CC7-BACHELOR OF COMPUTER APPLICATION (33)

DISCRETE STRUCTURES

Time Allotted: 2 Hours   Full Marks: 60

The figures in the margin indicate full marks.

GROUP-A

Answer any *four* questions from the following   3×4 = 12

1. Construct the truth table for the proposition:
$$(P \to Q) \leftrightarrow (\neg Q \to \neg P)$$

2. Prove the logical equivalence:
$$(P \wedge Q) \vee (P \wedge \neg Q) \equiv P$$

3. Determine the big O notation for the function $f(n) = 4n^2 + 2n + 1$.

4. Define a simple graph and provide an example.

5. Define a partial ordering relation on a set, and provide an example.

6. Solve the recurrence $T(n) = 2T(n/2) + n$ using Master Theorem.

GROUP-B

Answer any *four* questions from the following   6×4 = 24

7. Prove that $1 + 3 + 5 + \cdots + (2n-1) = n^2$ for all positive integer n, by using Mathematical Induction.

8. Solve the linear homogeneous recurrence relation
$B(n) = 2B(n-1) - B(n-2)$ with initial conditions $B(0) = 1$ and $B(1) = 2$.

9. Explain Big Omega notation with suitable example.

10. A survey found that 40% of people like ice-cream, 30% like chocolate and 20% like both. If 100 people were surveyed how many people like either ice-cream or chocolate or both?

11.   State the Pigeonhole Principle in your own words and provide an example to illustrate its application.

12.   State Euler's theorem for Eulerian paths and cycles in a graph. How does it relate to the degrees of vertices?

GROUP-C

Answer any *two* questions from the following $12 \times 2 = 24$

13.(a) Define a tree in graph theory. What are the key properties of a tree and how does it differ from a general graph?   6+6

   (b) Explain a spanning tree with example.

14.   Solve the recurrence relation $a_n = 2a_{n-1} + n^2$ with initial condition $a_0 = 1$ using generating functions.   12

15.(a) Determine whether the following compound proposition is a tautology: 6+6
$$(p \wedge q) \vee (\neg p \wedge \neg q)$$

   (b) Use De Morgan's laws to rewrite the expression $\neg(p \wedge \neg q)$ in terms of negations of $\neg p$ and $\neg q$.

16.   Discuss the properties of binary relations with suitable examples.   12

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