DECEMBER 2024 **U/ID 32514/UCM5C**

Time : Three hours Maximum : 75 marks

PART A — (10 × 2 = 20 marks)

Answer any TEN questions.

1. How to represent a set?

2. What is the representation of positive integers?

3. What are the properties of divisibility of integers?

4. How do you solve conjunctive normal form?

5. Show the distributive properties of Boolean algebra.

6. Give an example for DNF.

7. What are the 3 combinational logic circuits?

8. Show the truth table for XOR Gate.

9. Define recurrence relation.

10. What is the formula for generating functions?

11. Define Euler circuit.

12. What is open walk?

PART B — ($5 \times 5 = 25$ marks)

Answer any FIVE questions.

13. Show that for any integer n : $11^{n+2} + 12^{2n+1}$ is divisible by 133.

14. Convert $(101011101)_2$ to decimal notation.

15. Determine the PDNF without constructing the truth table for the expression

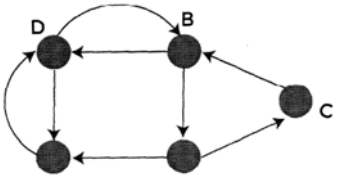
$X \to ((X \to Y) \wedge \neg(\neg Y \vee \neg X))$.

16. Obtain the PDNF and PCNF with the help of equivalence for the expression

$(\neg X \to Z) \wedge (Y \leftrightarrow X)$

17. Simplify the expression $x = (\overline{A} + B)(A + B + D)\overline{D}$.

18. Solve the recurrence relation $a_n = a_{n-1} + n$ with initial term $a_0 = 4$.

19. 

The sequence related to the above graph is:

- D, B, E, C, B
- D, A, D, A, D
- D, A, B, E, D
- D, B, E, C, B, A, D

(a) Determine the sequences which are the directed walks from the above given sequences.

(b) Determine the lengths of the directed walks.

(c) Determine the directed walks, which are also directed paths.

PART C — ($3 \times 10 = 30$ marks)

Answer any THREE questions.

20. Using the mathematical induction prove that

$1^2 + 2^2 + 3^2 + ... + n^2 = (1/6)\{n(n+1)(2n+1)\}$ for all $n \in N$.

21. Obtain the PDNF and PCNF for the expression $(X \wedge Y) \vee (\neg X \wedge Z)$.

22. Explain the various logic gates with examples.

23. Let a_n be the number of $1 \times n$ tile designs you can make using 1×1 squares available in 4 colors and 1×2 dominoes available in 5 colors.

    (a) First, find a recurrence relation to describe the problem. Explain why the recurrence relation is correct (in the context of the problem).

    (b) Solve the recurrence relation. That is, find a closed formula for a_n.

24. Prove that in a graph, any walk that starts and ends with the same vertex and has the smallest possible non-zero length, must be a cycle.

———————