No. of Printed Pages : 6 **MCS–212**

MASTER OF COMPUTER APPLICATIONS (MCA-NEW)

Term-End Examination

June, 2025

MCS-212 : DISCRETE MATHEMATICS

Time : 3 Hours *Maximum Marks : 100*

Weightage : 70%

Note : *Question No.* ***1*** *is compulsory. Attempt any* ***three*** *questions from the rest.*

---

1. (a) Create a truth table for the expression $(P \wedge Q) \rightarrow (P \vee Q)$. 5

   (b) Using proof by contradiction, demonstrate that the square rest of 3 is irrational. 5

   (c) If M = {1, 2, 3, 4} and N = {1, 2, 7}, calculate the symmetric difference MΔN. 5

(d) Given a DFA that recognizes a language L, construct a DFA that recognizes the complement of L. 5

(e) Solve the recurrence relation : 5

$$T(n) = 2T(n-1) - 1$$

with initial condition T(1) = 3.

(f) In how many ways can you arrange the letters of word 'ALGORITHM' such that the vowels (A, O, I) always appear together ? 5

(g) Given a graph with 5 vertices and the following edges :

(1, 2), (2, 3), (3, 4), (4, 5) and (5, 1),

can you color the vertices with three colors such that no two adjacent vertices have the same color ? 5

(h) Is the complete graph K5 Eulerian ? Explain why or why not. 5

2. (a) What is the Kleene closure operation, denoted as * ? Provide an example of using the Kleene closure on a set of languages. 5

(b) What are the *five* laws of Boolean algebra ? 5

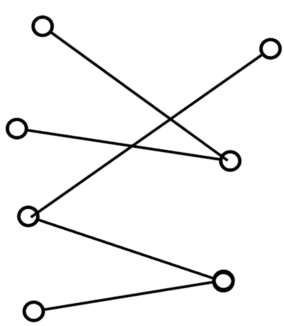
(c) In a tennis tournament, each entrant plays a match in the first round. Next, all winners from the first round play a second-round match. Winners continue to move on to the next round, until finally only one player is left as the tournament winner. Assuming that tournaments always involve $n = 2^k$ players, for some k, find the recurrence relation for the number round in a tournament of n players. 5

(d) In a bipartite graph, set A has 6 vertices and set B has 7 vertices. If the graph has 15 edges, is it a complete bipartite graph or not ? Justify your answer. 5

3. (a) Prove that : 5

$$p \Leftrightarrow q \equiv (\sim p \vee q) \wedge (p \wedge \sim q)$$

(b) Describe the term 'chromatic number'. In the following graph, find the chromatic number : 5



(c) Write short notes on the following : 10

(i) Euler graph

(ii) Hamiltonian graph

4. (a) How many 2-digit even numbers can be formed from the digits 1, 2, 3, 4 and 5, if the digit can be repeated ? 5

(b) Prove the following, using truth table : 5

(i) $\sim(A \vee B) = \sim A \wedge \sim B$

(ii) $\sim(A \wedge B) = \sim A \vee \sim B$

(c) Explain the following with suitable example for each : $4 \times 2\frac{1}{2} = 10$

(i) Paths

(ii) Circuits

(iii) Cycles

(iv) Spanning trees

5. (a) Explain briefly the following with the help of examples : 5

(i) Mealy Machines

(ii) Moore Machines

(b) Suppose you have created an algorithm and that algorithm does not run on Turing Machine (TM) for arbitrary amount of space and time, what does this statement imply ? 5

(c) Generate the recurrence relation for Fibonacci series. Find first 5 terms. Explain the importance of recurrence relation in Computer Science. 10

× × × × ×