

**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 root of 3 is
irrational. 5
- (c) If $M = \{1, 2, 3, 4\}$ and $N = \{1, 2, 7\}$,
calculate the symmetric difference
 $M \Delta N$. 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 K_5 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

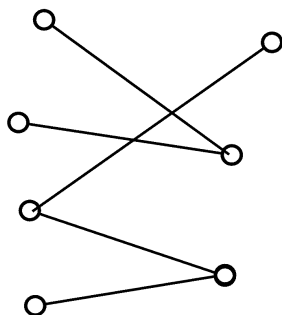
relation for the number round in a tournament of n players. 5

- (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

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