

**MASTER OF COMPUTER
APPLICATIONS (MCA-NEW)**

Term-End Examination

December, 2024

MCS-212 : DISCRETE MATHEMATICS

Time : 3 Hours

Maximum Marks : 100

Weightage : 70%

Note : (i) *Question No. 1 is compulsory.*

(ii) *Attempt any **three** questions from the rest.*

1. (a) Using proof by contradiction, demonstrate that the square root of 2 is irrational. 5
- (b) Create a truth table for the logical expression : 5
- $$(P \wedge Q) \vee (\sim P)$$
- (c) Explain what is the complement of a set and find the complement of $A = \{x \mid x \text{ is an even number}\}$. 5

- (d) Build a finite automata that accepts only the words baa , ab and abb and no other words. Also, write the corresponding regular expression. 5

- (e) Given the recurrence relation :

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

with initial condition $T(1) = 1$. Verify using mathematical induction that $T_n = 2^n - 1$. 5

- (f) If you have 5 red balls and 3 blue balls, how many different ways can you arrange them in a row ? 5

- (g) Write and prove Handshaking theorem. 5

- (h) Is the graph C_5 Hamiltonian ? Explain why or why not. 5

2. (a) What is the Kleene closure of the language $L = \{a, aa, aaa\}$? Write down the set of strings in L^* . 5

- (b) Write Pigeonhole principle. How is it different from Generalized Pigeonhole principle ? 5

- (c) Differentiate between Turing Acceptable Language and Turing Decidable Language.

5

- (d) What is a bipartite graph ? Give any *one* application of bipartite graphs. In a bipartite graph, set A contains 5 vertices and set B contains 6 vertices. How many edges can this bipartite graph have at most ?

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3. (a) P : Good mobile phones are not cheap.

Q : Cheap mobile phones are not good.

Prove that P is equivalent to Q.

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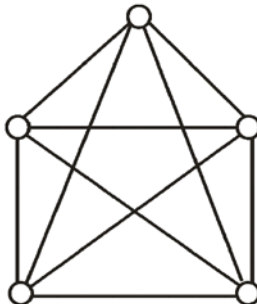
- (b) Prove that :

5

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

- (c) Describe vertex colouring. In the following graph, find chromatic number :

5



(d) Write short notes on the following : 5

(i) Planar graph

(ii) Isomorphism

4. (a) Given 6 flags of different colour, how many different signals can be generated if a signal requires the use of 2 flags one below the other ? 5

(b) Differentiate between predicate logic and propositional logic. Also, give De-Morgan's laws for both logic. 5

(c) Design a Boolean circuit for the output of the following table : 4

I/P		O/P
A	B	Sum
0	0	0
0	1	1
1	0	1
1	1	0

(d) Differentiate between Eulerian graph and Hamiltonian graph. Also, give Dirac's and Ore's criterion. 6

5. (a) Briefly explain the following with suitable example : 5
- (i) Non-deterministic FA
 - (ii) Kleene closure
- (b) Check that $a_n = \frac{3}{2}n - 2$ is a solution to the recurrence relation $a_n = 2a_{n/2} + 2$, where n is a power of 2 and $a_2 = 1$. 5
- (c) Write short notes on the following : 5+5
- (i) Undecidable problem
 - (ii) Halting problem

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