No. of Printed Pages : 6 **MCS–212**

MASTER OF COMPUTER APPLICATIONS (MCA) (NEW)

Term-End Examination

December, 2023

MCS-212 : DISCRETE MATHEMATICS

Time : 3 Hours *Maximum Marks : 100*

Weightage : 70%

Note : *Question No.* ***1*** *is compulsory and carries 40 marks. Attempt any* ***three*** *questions from the rest four questions (Question Nos.* ***2*** *to* ***5****).*

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1. (a) Apply the precedence rules and write the truth table for the expression $p \rightarrow q \wedge \sim r \leftrightarrow r \oplus q$. 4

(b) Show that $[(p \to q) \wedge \sim q] \to \sim p$ is a tautology, without using truth table. 4

(c) What is Dynamic Programming ? Write *four* major steps involved in dynamic programming. 4

(d) Explain Conjunctive Normal Form (CNF) with a suitable example. 4

(e) Find inverse of the function $f(x) = \dfrac{x-2}{x-3}$. 4

(f) What is Kleene closure ? Write Kleene closure for the following set of alphabets : 4

(i) $\Sigma = \{aa, b\}$

(ii) $\Sigma = \{a, ba\}$

(g) What is a Turing machine ? Discuss the elements of the six tuple form of the Turing machine (Half State Version). 4

(h) Suppose A and B are mutually exclusive events such that P(A) = 0.3 and P(B) = 0.4. What is the probability that : 4

(i) A or B occurs

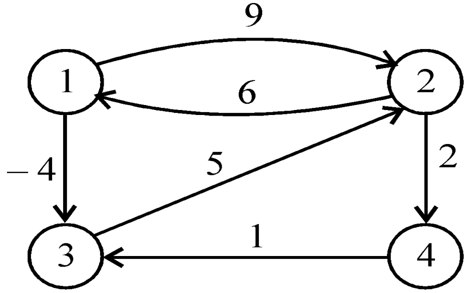
(ii) Either A or B does not occur ?

(i) State Pigeonhole principle and Inclusion-Exclusion principle. 4

(j) Write and prove the Handshaking theorem. 4

2. (a) Write down the statement "If it is raining and the rain implies that no one can go to play the match, then no one can go to play the match" as a compound proposition. Show that this proposition is a tautology, by using the principles of logical equivalence. 7

(b) Write Floyd Warshall's algorithm and apply it to find the shortest path for the graph given below (starting from vertex 1) : 8



(c) Realize Conjunction, Disjunction and Negation (*i.e.* AND, OR and NOT) operation using switches. Also write truth table for each. 5

3. (a) If A is a set with n elements, then prove that $|P(A)| = 2^n$, where P(A) is power set of A. 5

   (b) Compare Moore and Mealy machines. 5

   (c) What is Turing Machine ? Explain the working of the constituent components of the Turing machine with the help of a block diagram. 10

4. (a) Suppose we have three teams T_1, T_2 and T_3. Team T_1 has 4 members, T_2 has 5 members and T_3 has 6 members in a competition. Suppose we want to select two persons from the same team, to become captain and vice-captain for each team. In how many ways this can be done ? 5

(b) Suppose 5 points are chosen at random within or on the boundary of an equilateral triangle of side 1 metre. Use Pigeonhole principle to show that we can find two points at a distance of at most 1/2 metre. 5

(c) Discuss the application of Inclusion-Exclusion principle for finding the number of derangements with a suitable example. 5

(d) Given the recurrence relation $C_n = C_{n-1} + (n-1)$ with boundary condition $C_2 = 1$, show that $C_n = \frac{n(n-1)}{2}$, where C_n is the number of comparisons required to sort a list of *n* integers. 5

5. Explain any *five* of the following with suitable example for each : 5×4=20

(i) Bipartite graph and its applications

(ii) Circuits and cycles in a graph

(iii) Edge connectivity and Edge traceability

(iv) Hamiltonian graph and Ore's criterion

(v) Travelling salesman problem

(vi) Planar graphs