No. of Printed Pages : 7   **MCS-212**

MASTER OF COMPUTER

APPLICATIONS

(MCA) (NEW)

Term-End Examination

December, 2021

MCS-212 : DISCRETE MATHEMATICS

Time : 3 Hours   *Maximum Marks : 100*

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

1. (a) Make the truth table for :   5

   (i) $p \rightarrow q \wedge \sim r$

   (ii) $p \oplus q \wedge r \rightarrow p \wedge r$

P. T. O.

(b) Show that $\sqrt{5}$ is irrational using the proof by contradiction.   5

(c) If A = {a, b, c} and B = {x, y, z}, find :   2+2+1

   (i) $A \times B$

   (ii) $A \times A$

   (iii) $A \times \phi$

(d) Find the regular expression for the language :   3

$$L = \{aa, aba, abba, abbba, ...\}$$

(e) Give *one* difference between Deterministic Finite Automata and Non-deterministic Finite Automata.   2

(f) Find the order and degree of the following recurrence relations :   3

   (i) $a_n = a_{n-1} + a_{n-2}$

   (ii) $a_n = \sqrt{a_{n-1}} + a_{n-2}^2$

(g) Determine the number of integer solutions of the equation ; 4

$$(x_1 + x_2 + x_3 + x_4) = 7,$$

where $x_i \geq 0$ for all $i = 1, 2, 3, 4$.

(h) How many three-letter words, which has vowel in the middle position, can be formed using the letter of English alphabets ? 3

(i) Consider graph $G = K_4$ on four vertices a, b, c, d. Make three sub-graphs of graph G. 3

(j) Show that C_6 is a bipartite graph. 3

(k) Does the following graph have Eulerian circuit ? If yes, give the Eulerian circuit, if no, explain the reasons : 4
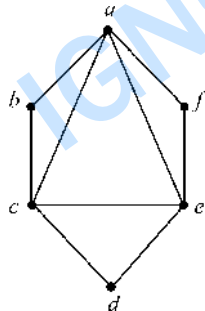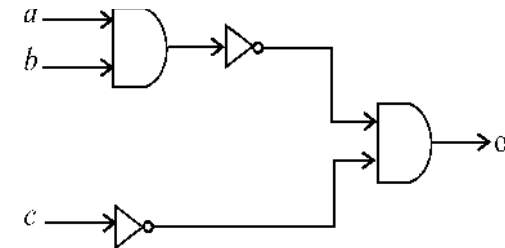
2. (a) What is a tautology ? Find, if the following is a tautology : 5

$$[(p \rightarrow q) \wedge \sim q] \rightarrow \sim p$$

(b) Explain how principle of mathematical induction can be used to prove : 8

$$1^2 + 2^2 + 3^2 + \ldots\ldots n^2 = \frac{n}{6}(n+1)(2n+1), \forall n \in N$$

(c) Find the Boolean expression for the output of the logic circuit given below : 3

(d) Find, if the following Boolean expressions are equivalent over the two-element Boolean algebra $\mathbf{B} = \{0, 1\}$: 4
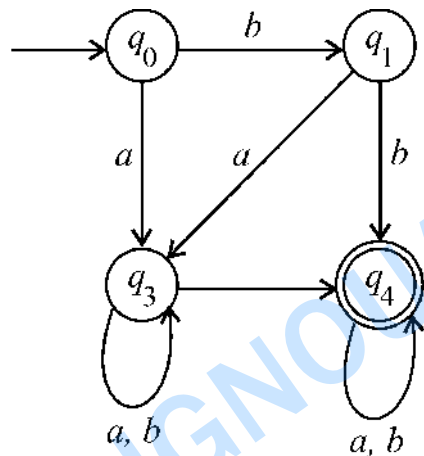
$$X = (a \wedge b) \vee (a \wedge c) \text{ and } Y = a \wedge (b \vee c')$$

3. (a) Find the power set of the set A = $\{a, b, c, d\}$.

3

(b) If A = {1, 2, 3, 4} and B = {2, 3, 4, 5, 6, 7} and $f : A \to B$ is $f(x) = x + 1$, then find the domain and range of f. 4

(c) If $f(x) = x^2$ and $g(x) = x+1$, then find $f \circ g(x)$ and $(g \circ f)(x)$. 4

(d) Explain the meaning of each symbol in the finite automata definition $M = (Q, \Sigma, \delta, q_0, F)$. 3

(e) Consider the following finite automata :

(i) What would be the values of Q, Σ, δ, q_0 and F for the automata given above ?

3

(ii) Give one string that will be accepted and one string that will not be accepted by this finite automata. 3

4. (a) If there are 7 men and 5 women, how many circular arrangements are possible in which women do not sit adjacent to each other ? 5

(b) What is the probability that a number between 1 to 1,000 is divisible by neither 2, nor 3 nor 5 ? 5

(c) What is the meaning of 'distributions' of objects ? Explain with the help of an example. 5

(d) Explain the Fibonacci numbers. Also explain the recurrence relation for Fibonacci numbers. 5

5. (a) Define the following terms in the context of a graph, with the help of an example : 8

(i) Digraph

(ii) Complete graph of three vertices

(iii) Degree of a vertex

(iv) A regular graph

(b) Explain the terms tree and forest in the context of graphs, with the help of an example.   5

(c) What are Hamiltonian graphs ? Explain with the help of an example.   5

(d) State the travelling salesperson problem. 2