

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

(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

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

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

[ 3 ]

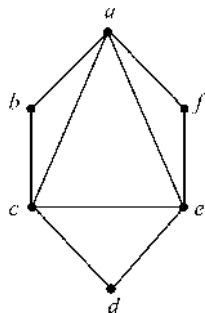
MCS-212

- (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



P. T. O.

[ 4 ]

MCS-212

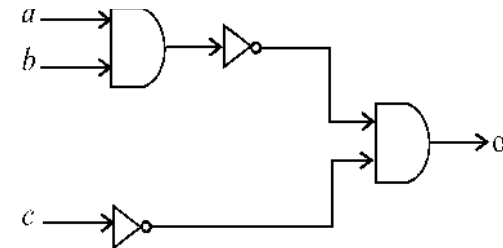
2. (a) What is a tautology ? Find, if the following is a tautology : 5

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

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

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

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



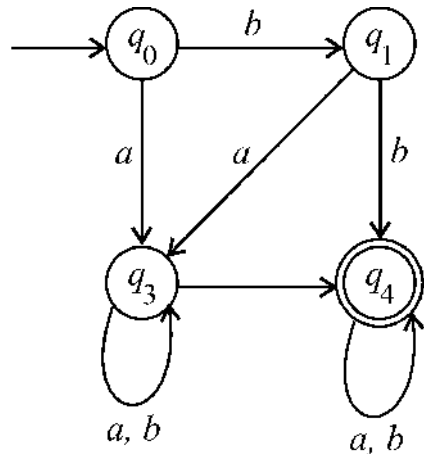
- (d) Find, if the following Boolean expressions are equivalent over the two-element Boolean algebra  $\mathbf{B} = \{0, 1\}$  : 4

$$X = (a \wedge b) \vee (a \wedge c) \text{ and } Y = a \wedge (b \vee c')$$

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  $f: A \rightarrow B$  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  $Q, \Sigma, \delta, q_0$  and  $F$  for the automata given above ?

3

P. T. O.

- (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