

Roll No. ....

Total Pages : 4

**220101**

December, 2019

MCA- 1 SEMESTER

Mathematical Foundation of Computer Science

(MCA-17-101)

Time : 3 Hours]

[Max. Marks : 75

Instructions :

1. It is compulsory to answer all the questions (1.5 marks each) of Part-A in short.
2. Answer any four questions from Part-B in detail.
3. Different sub-parts of a question are to be attempted adjacent to each other.

**PART - A**

1. (a) Let  $f(x) = x^2 + 5$  and  $g(x) = 2x + 3$ . Compute  $f \circ g(x)$  and  $g \circ f(x)$ . (1.5)
- (b) Which specific property is possessed by an abelian group. (1.5)
- (c) Define tautology and contradiction with the help of example. (1.5)

6. (a) Make a planar graph and show that it is planar using Euler's formula. (4)
  - (b) Write algorithm to find shortest path in a weighted graph. (6)
  - (c) Describe Chomsky hierarchy of grammars. (5)
7. (a) Convert the following Mealy machine to Moore machine. (5)

Current State	Input Symbol			
	a		b	
	Next State	Output	Next State	Output
→ q <sub>0</sub>	q <sub>1</sub>	1	q <sub>2</sub>	1
q <sub>1</sub>	q <sub>2</sub>	0	q <sub>0</sub>	1
q <sub>2</sub>	q <sub>0</sub>	1	q <sub>1</sub>	0

- (b) Convert the following NFA to DFA. (5)

Current state	Input symbol	
	a	b
→ q <sub>0</sub>	q <sub>2</sub>	q <sub>0</sub> , q <sub>1</sub>
q <sub>1</sub>	q <sub>2</sub>	q <sub>1</sub>
q <sub>2</sub>	q <sub>1</sub> , q <sub>f</sub>	q <sub>0</sub>
q <sub>f</sub>	-----	----
q <sub>f</sub> is the final state.		

- (c) Design the finite automata for the following regular expressions. (5)
- (i)  $1(10)^*(11+00)$  (ii)  $(a+b)^*cc(d+e)$

- (d) Write truth table for implication and bi-implication. (1.5)
- (e) Write the following sentence in the form of predicate:  
"Ram and Sham are friends." (1.5)
- (f) Name the characteristic properties possessed by partial order relation. (1.5)
- (g) Define cut point with the help of an example. (1.5)
- (h) What is the difference between Eulerian circuit and Hamiltonian circuit. (1.5)
- (i) Write the language corresponding to following regular expression :  $(a + b^*)cc$ . (1.5)
- (j) In the conventional statement,  $G = (V, \Sigma, P, S)$  define the meaning of  $V$  and  $\Sigma$ . (1.5)

### PART - B

2. (a) Let  $A = \{1, 2, 3, 4, 5\}$ . A relation  $R$  is defined on  $A$  such that  $aRb$  iff  $a \leq b$ . Make the relation matrix for  $R$ . Check if relation  $R$  is reflexive, symmetric, asymmetric and antisymmetric. (6)
- (b) Explain recursively defined function with the help of two examples. (4)
- (c) Write short note on permutation group. (5)

3. (a) State and prove Langrange's Theorem. (6)
- (b) Describe Modus ponen and Modus tollen with the help of suitable example. (4)
- (c) Write the following sentences using quantifiers and predicate logic :  
All that glitters is not gold.  
Some bird don't fly. (5)
4. (a) Obtain principal disjunctive normal form of  $(\sim p \vee \sim q) \rightarrow (\sim p \wedge r)$  (5)
- (b) Let  $A = \{a, b, c\}$ . Let  $P(A)$  be the power set of  $A$ . Prove that  $(P(A), \subseteq)$  is a poset. Draw Hasse diagram for this relation and check if it is a lattice. (10)
5. (a) Define the following types of lattices with the help of example:  
(i) Complemented Lattice.  
(ii) Distributed Lattice. (6)
- (b) Define the following types of graphs with the help of suitable examples:  
Weighted Graph, Multigraph, Subgraph. (3)
- (c) Explain isomorphism and homomorphism. (6)