1 SEM MCA (NCBCS) 101

2019

(December)

COMPUTER APPLICATION

Paper : MCA-101

(Theory of Computer Science)

Full Marks : 75

Time : Three hours

The figures in the margin indicate full marks for the questions.

Answer Question No. **1** *and* ***any four*** *from the rest.*

1. *(a)* Fill in the blanks : 1×5=5

   (i) CLF can be recognized by _______.

   (ii) Push down machine represents _______ grammar.

   (iii) If two FSM are equivalent they should have the same number of _______.

(iv) The number of vertices in a binary tree is ______.

(v) If L is the set accepted by an NDFA, then there exists a ______ which also accepts L.

(b) State True **or** False for the following: 1×5=5

(i) If $s = abcd$ is defined over $\Sigma = \{a, bc, d\}$ then reverse of the string s is *dcba*.

(ii) If $\Sigma = \{aa, b\}$, then $|aaaa\ baa\ bb| = 5$.

(iii) Every *nfa* can be converted into an equivalent *dfa*.

(iv) A regular language cannot be infinite.

(v) A graph is said to be a tree if it is connected and no circuit.

(c) Construct grammars for the following languages— 2+2=4

(i) $L = (a, b)^*$ where b appears before a

(ii) $L = (a + b)^*$, where there is at least one b

(d) Define Levi's theorem. 1

2. (a) Prove the following by principle of Induction : 2+2=4

(i) $\sum_{k=1}^{n} k^2 = \frac{n(n+1)(2n+1)}{6}$

(ii) $1+4+7+....+(3n-2) = \frac{n(3n-1)}{2}$

(b) State the Pigeonhole principle. 1

(c) Construct a Mealy m/c equivalent to the Moore m/c given in table 1. 5

Table–1

Present state	Next state		Output
	$a=0$	$a=1$	
$\to q_0$	q_3	q_1	0
q_1	q_1	q_2	1
q_2	q_2	q_3	0
q_3	q_3	q_0	0

(d) Given a grammar $G : S \to 0S1,\ S \to \wedge$

Find $L(G)$. 2

(e) Define equivalence relation. 3

3. (a) Given a grammar G: 3

$S \to a|abSb|aAb|$

$A \to bS|aAA|b$

Show that the grammar is ambiguous.

(b) Represent the following sets in regular expression— 3

(i) $\{a^2, a^5, a^8, \ldots\}$

(ii) $\{a^n \mid n \text{ is divisible by } 2 \text{ or } 3\}$

(iii) The set of all strings over $\{0, 1\}$ beginning and ending with 00

(c) Find the highest type no grammar for the following productions—

(i) $S \to Aa,\ A \to c \mid Ba,\ B \to abc$

(ii) $S \to ASB \mid d,\ A \to aA$

(iii) $S \to aS \mid ab.$ 3×1=3

(d) Construct a minimum state automata given in Table 2. 6

Table 2

θ \ Σ	0	1
$\to q_0$	q_0	q_3
q_1	q_2	q_5
q_2	q_3	q_4
q_3	q_0	q_5
q_4	q_0	q_6
q_5	q_1	q_4
q_6	q_1	q_3

4. *(a)* Consider the ndfa given in *Figure* 3.

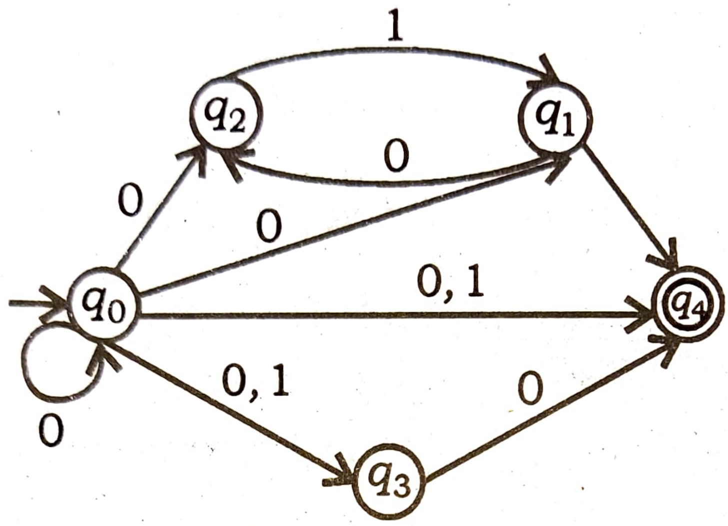

Figure 3

Convert it to an equivalent dfa. 5

(b) Consider the finite automata (*Fig.* 4) with $\wedge$-move.

Obtain an equivalent automation without $\wedge$-move. 5

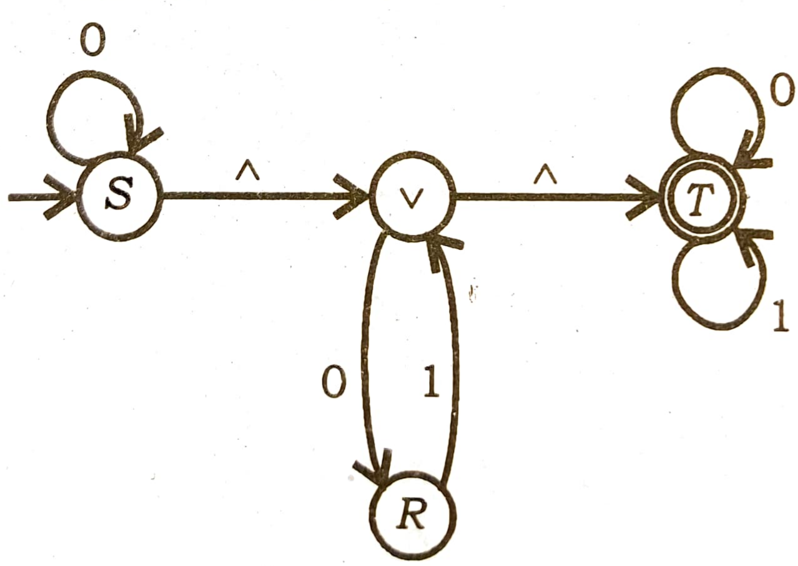

Fig. 4

(c) Given two DFAs M and M' (*Fig.* 5) over $\{0, 1\}$.

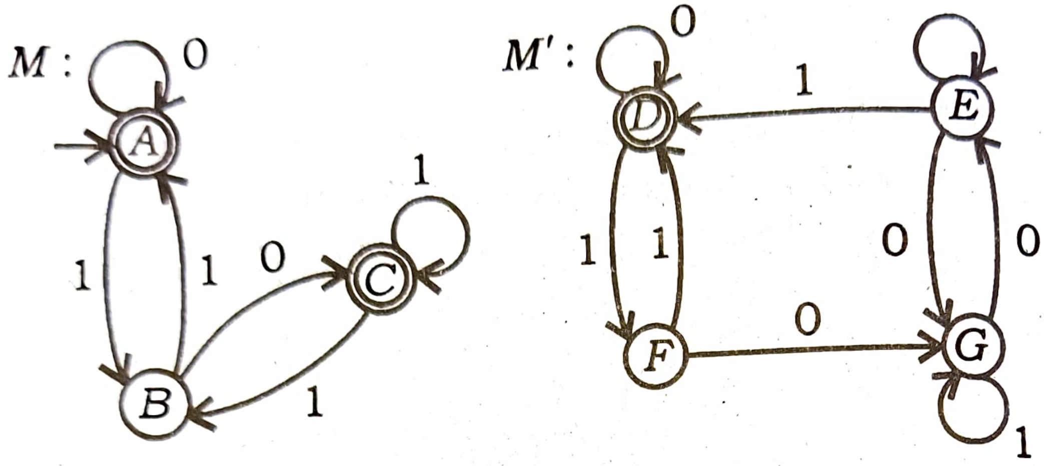

Figure 5

Prove that the M and M' are equivalent. 5

5. (a) Find the regular expression corresponding to the automata (*Fig.* 6) using Arden's theorem. 5

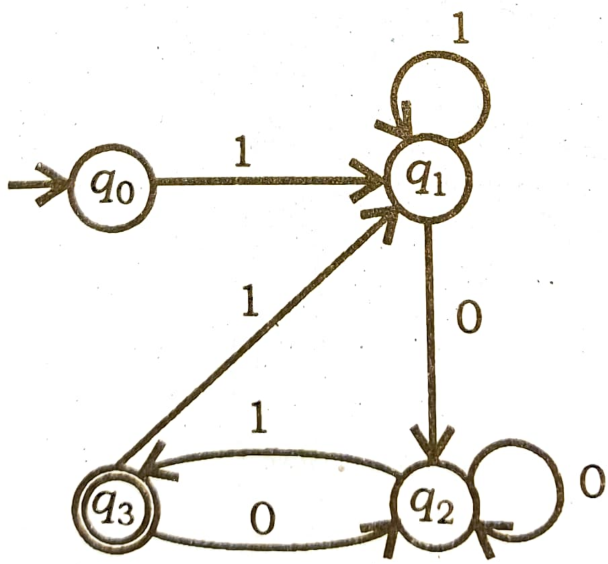

Fig. 6

(b) Prove the language given by $A = \{a^n b^n \mid n \geq 0\}$ is not regular using pumping lemma. 5

(c) Find a reduced grammar equivalent to the grammar having productions 5

$P : S \to AC \mid B,\ A \to a,\ C \to c \mid BC,\ E \to aA \mid c$

6. Write short notes on : ***(any three)*** 5×3=15

(a) CNF

(b) Chomsky classification of Grammars

(c) Turing m/c

(d) Push down automata

(e) Parsing.

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