63/2 (SEM-3) MCA 3.5

2022

(Held in 2023)

MCA

(Theory Paper)

Paper Code : MCA 3.5

(Formal Language and Automata Theory)

Full Marks – 75

Pass Marks – 30

Time – Three hours

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

This paper contains three sections SECTION–A, SECTION–B and SECTION–C. SECTION–A contains 10 questions, each question carries 1 mark. In SECTION–B out of 10 questions only 5 questions are compulsory, each question carries 5 marks. In SECTION–C out of 6 questions only five questions are compulsory each carries 8 marks.

[Turn over

SECTION-A

Answer the following questions : $1 \times 10 = 10$

1. Match the following :

List-A	List-B
(i) Type 0	(A) Regular Grammar
(ii) Type 1	(B) CFG
(iii) Type 2	(C) Context-Sensitive
(iv) Type 3	(D) Turing Machine

   (a) i-B, ii-A, iii-D, iv-C

   (b) i-D, ii-A, iii-A, iv-C

   (c) i-C, ii-A, iii-B, iv-D

   (d) i-D, ii-C, iii-B, iv-A

2. What is the Regular Expression Matching one or More Specific Characters ?

   (a) x   (b) +

   (c) *   (d) &

3. Which of the following strings is not generated by the following grammar ?

   $S \rightarrow SaSbS | \varepsilon$

   (a) aabb   (b) abab

   (c) aababb   (d) aaabbb

4. Regular expression (x+y)+(x+y) denotes the set

   (a) {xy, xy}   (b) {xx,xy,yx,yy}

   (c) {x, y}   (d) {x, y, xy}

5. Given grammar $S \rightarrow (L) | a \ L \rightarrow L, S|S$ Which of the input recognised by the grammar Select one :

   (a) ((a, a), a)   (b) (a, a)

   (c) ((a, a, a), a)   (d) All of the above

6. The grammar $E \rightarrow E+E|E*E|a$

   (a) Ambiguous

   (b) Unambiguous

   (c) Depends on the given sentence

   (d) None of the above

7. The main difference between DFA and NDFA

(a) In DFA from any given state there cannot be any alphabet leading to two different states

(b) In NDFA empty transition may be present

(c) In NDFA from any given state there cannot be any alphabet leading to two different states

(d) In DFA empty transition may be present

8. The set {a, aa, aaaa, aaaaaa, ...} represents the regular expression

(a) a*   (b) (aa)*

(c) aa*   (d) None of the above

9. A Mealy machine accept a string w of length n. The length of the output string is

(a) n+1   (b) n−1

(c) n^2 (d) n

10. The output of a Moore machine depends on

(a) the present state only

(b) the present state and the input symbol

(c) the input symbol only

(d) None of these

SECTION-B

Answer any *five* of the following questions :

5×5=25

1. Construct the following DFA :

(a) Construct a DFA for the set of string over {a, b, c} having **bca** as a substring.

(b) Construct a DFA for the set of string {a, b} ends in the substring **ba**.

2. Construct the following Regular Expression :

(a) The set of all string over {a, b} containing at most 2a's.

(b) {000, 0001, 00011, 000111, ...}.

3. Construct a finite automation for the regular language (ab + c*)*b.

4. Define Mealy and Moore machine.

5. Construct a regular grammar G generating the regular set represented by P=a*(a+b)(a+b)*.

6. If G is the grammar S→SbS/a, show that G is ambiguous.

7. If G be the grammar S→0B/1A, A→0/0S/1AA, B→1/1S/0BB. For the string 00110101, find leftmost derivation.

8. Discuss the model of PDA with ID.

9. Prove the following identities of regular expression :

   (i) $(PQ)^*P = P(QP)^*$

   (ii) $\varepsilon + R = R + \varepsilon$.

10. Define Chomsky Classification of languages with example.

SECTION–C

Answer any *five* of the following questions :

$8 \times 5 = 40$

1. Construct a minimum state automaton equivalent to the finite automata from the given transition table :

State/Σ	0	1
q_0	q_1	q_5
q_1	q_6	q_2
q_2*	q_0	q_2
q_3	q_2	q_6
q_4	q_7	q_5
q_5	q_2	q_6
q_6	q_6	q_4
q_7	q_6	q_2

2. If L is regular then L^T is also regular.

3. Define Chomsky normal form (CNF). Find a grammar in CNF equivalent to

   $S \rightarrow aAbB$, $A \rightarrow aA/a$, $B \rightarrow bB/b$.

4. Construct a PDA accepting the language $L = \{a^n b^m c^n / m, n \geq 1\}$ by null store. Construct the corresponding Context-free grammar accepting the same set.

5. What is pumping lemma ? Show that the set $L = \{a^{i^2} / i \geq 1\}$ is not regular.

6. What are unit and null production ? Find the reduced grammar equivalent to the grammar $S \rightarrow aAa$, $A \rightarrow bBB$, $B \rightarrow ab$, $C \rightarrow aB$.