MCA–18

Formal Language and Automata

Master of Computer Application
(MCA–11/16/17)
Fifth Semester, Examination, 2017

Time : 3 Hours **Max. Marks : 80**

Note : This paper is of **eighty (80)** marks containing **three (03)** sections A, B and C. Learners are required to attempt the questions contained in these sections according to the detailed instructions given therein.

Section–A
(Long Answer Type Questions)

Note : Section 'A' contains four (04) long answer type questions of nineteen (19) marks each. Learners are required to answer *two* (02) questions only.

1. (a) What do you mean by Automata ? How many types of automata ? Explain with suitable examples.

   (b) Construct the DFA equivalent to :

   $M = (\{q_0, q_1, q_2, q_3\}), \{a, b\}, \delta, q_0, \{q_3\}$ where transition δ (delta) is defined as :

State	a	b
$\rightarrow q_0$	q_0, q_1	q_0
q_1	q_2	q_1
q_2	q_3	q_3
(q_3)		q_2

2. Explain about Turing Machine Model. How many types of representation of Turing Machine ? Design a Turing Maching to recognize a language $L = \{a^n b^n c^n | n \geq 1\}$.

3. (a) What are the ways in which NPDA differs from a PDA ? Compare PDA and FA.

   (b) Design a PDA which accepts a language :

   $$L = \{0^n 1^m 0^n | m \geq 1, n \geq 1\}$$

   by null store.

4. (a) Explain the Halting Problem of Turing Machine.

   (b) State the Post's Correspondence Problem. Obtain the solution for the following system of post correspondence problem : A = {ba, abb, bab}, B = {bab, bb, abb}.

Section–B
(Short Answer Type Questions)

Note : Section 'B' contains eight (08) short answer type questions of eight (08) marks each. Learners are required to answer *four* (04) questions only.

1. Construct the grammar accepting each of the following sets :

   (i) $L = \{0^n 1^m 0^m 1^n : m, n \geq 1\}$

   (ii) $L = \{0^n 1^{2n} : n \geq 1\}$

2. What do you mean by Chomsky classification of language ? Discuss in detail.

3. What do you mean by Regular Expression ? Construct NFA equivalent to the Regular Expression :

   $$= (0 + 1)^*(00 + 11)\ (0 + 1)^*$$

4. State the Pumping Lemma Theorem and prove that a language L = $\{a^p : p \text{ is prime number}\}$ is not regular.
5. Construct a CFG which accepts N (A) where $A = (\{q_0, q_1\}, \{a, b\}, \{z_0, z\}, \delta(\text{Delta}), q_0, z_0, \phi)$ and δ (Delta) is given by :

$$\delta(q_0, b, z_0) = \{(q_0, zz_0)\}$$

$$\delta(q_0, \wedge, z_0) = \{(q_0, \wedge)\}$$

$$\delta(q_0, b, z) = \{(q_0, zz)\}$$

$$\delta(q_0, a, z) = \{(q_1, z)\}$$

$$\delta(q_1, b, z) = \{(q_1, \wedge)\}$$

$$\delta(q_1, a, z_0) = \{(q_0, z_0)\}$$

6. What do you mean by Recursive and Recursive Enumerable Language ? Explain with suitable example.
7. Explain Church's Thesis in detail.
8. Construct a DFA accepting all string over {0, 1} :
   (i) Having odd number of 0's
   (ii) Having even number of 0's and even number of 1's

Section–C
(Objective Type Questions)

Note : Section 'C' contains ten (10) objective type questions of one (01) mark each. All the questions of this section are compulsory.

1. Push down machine represents :
   (a) Type 0 grammar

(b) Type 1 grammar

(c) Type 3 grammar

(d) Type 4 grammar

2. Finite state machine can recognize :

(a) Type 0 grammar

(b) Type 2 grammar

(c) Only regular grammar

(d) Any unambiguous grammar

3. The basic limitation of deterministic finite automata (DFA) is that :

(a) it cannot remember any information

(b) it sometimes recognizes grammar that are not regular

(c) it sometimes fails to recognize regular grammar

(d) All of these

4. Which of the following is most powerful ?

(a) DFA

(b) NDFA

(c) PDA

(d) Turing Machine

5. Regular expressions are closed under :

(a) Union

(b) Intersection

(c) Kleen star

(d) All of these

6. If L_1 and L_2 are regular languages then which of the following is also a regular language ?
   (a) $L_1 + L_2$
   (b) $L_1 . L_2$
   (c) L_1
   (d) All of these

7. Languages are proved to be regular or non-regular using pumping kemma.
   (a) True
   (b) False

8. CFG stands for :
   (a) Context free grammar
   (b) Context free graph
   (c) Context finite graph
   (d) Context finite grammar

9. The grammatical rules are called ..... .
   (a) Productions
   (b) Terminals
   (c) Non-terminal
   (d) None of these

10. A production is called nullable production if it is of the form :

    $A \rightarrow \wedge$ (where '$\wedge$' represents any single Non-Terminal)
    (a) True
    (b) False