S-845 Roll No. ……..

MCA–18

Formal Language and Automata

Master of Computer Application (MCA–11/16/17)

Fifth Semester, Examination, 2018

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

Note : This paper is of **eighty (80)** marks containing **three (03)** Sections A, B and C. 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. Design an NFA for the following languages :

   (i) $L = \{abab^n : n \geq 0\} \cup \{aba^n : n \geq 0\}$

   (ii) $L = \{a^n : n \geq 0\} \cup \{b^n a : n \geq 1\}$

   (iii) L = collection of {0, 1} which end with 1 but does not contain the substring 00.

   (iv) L is a language that accepts the language {*ab*, *abc*}*

   (v) L = (*bb** (*a* + *b*)

2. Construct a finite automata equivalent to the following regular expression is :
   (i) R = (1 (00)* 1 + 01* 0)*
   (ii) R = $(a + b)^*$ (abb)
   (iii) $(ab \mid ba)^*$ aa $(ab \mid ba)^*$
3. What are the limitations of finite automata ? How can we overcome from these limitations ? Design a PDA for language $L = \{a^n b^n \mid n \geq 1\}$.
4. What do you mean by CFG ? Write a CFG for the following languages :
   (i) $L = \{W W^R : W \in \{0,1\}^*\}$
   (ii) $L = \{W \subset W^R : W \in (a,b)^*\}$
   (iii) $L = \{a^{2n} b^m : n \geq 0, m \geq 0\}$

Section–B
(Short Answer Type Questions)

Note : Section 'B' contains eight (08) short answer type questions of eight (8) marks each. Learners are required to answer *four* (04) questions only.

1. (i) If $L_1 = \{ab, aa, baa\}$ and $L_2 = \{a, b\}$. Find $L_1.L_2$, $L_1 \cup L_2$, $L_1{}^*$ and $L_2{}^*$.
   (ii) If $L_1 = \{x, xy, x^2\}$ and $L_2 = \{y^2, xyx\}$ over $\{x, y\}$. Find L_1L_2, L_2^2 and L_2^{-2}.
2. What do you mean by DFA and NDFA ? Design a DFA that recognizes language :
   $$L = \{b^m a b^n : m, n > 0\}$$
3. Find the regular expression for the following languages :
   (i) $L_1 = \{a^n b^m : n \geq 1, m \geq 1, nm \geq 3\}$
   (ii) $L_2 = \{ab^n w : n \geq 3, w \in \{a,b\}^+\}$

4. Derivate Arden's theorem.
5. What is the relation between CFG and PDA ? Write the rules to convert the CFG into PDA.
6. What do you mean by decidable and undecidable language ?
7. What do you mean by derivation tree and the parse tree ? How many types of derivation are there ? Derivate the string 00110101 implementing all the methods of derivation using the following grammar :

$$S \rightarrow 0B \mid 1A$$

$$A \rightarrow 0 \mid 0S \mid 1AA$$

$$B \rightarrow 1 \mid 1S \mid 1BB$$

8. Design a Turing machine for acceptance of string $0^n 1^n$, where $n > 0$.

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. Regular grammar is :
   (a) Context free grammar
   (b) Non-context free grammar
   (c) Context sensitive grammar
   (d) None of these

2. The transition function of NFA is :
   (a) δ (delta) : $\theta \times \Sigma \rightarrow \theta$
   (b) δ (delta) : $\theta \times \Sigma \rightarrow \theta^n$
   (c) δ (delta) : $\theta \times \Sigma \rightarrow 2^\theta$
   (d) None of these
3. The finite automata can accept a language $L = \{a^n b^n \mid n \geq 1\}$.
   (a) True
   (b) False
4. Turing machine is an abstract model of computers.
   (a) True
   (b) False
5. Which of the following conversion is not possible (algorithmically) ?
   (a) Regular grammar to CFG
   (b) NDFA to DFA
   (c) NPDA to DPDA
   (d) Non-deterministic TM to deterministic TM
6. Pumping lemma is used to test whether a grammar is regular or not.
   (a) True
   (b) False
7. Recursively enumerable languages are not closed under :
   (a) Union

(b) Intersection

(c) Complementation

(d) Concatenation

8. Who did invert the Turing machine ?

(a) G. M. Turing

(b) Fred Turing

(c) Alosco Turing

(d) Alan Turing

9. If L is a regular language, then L^C is also a ..... language.

(a) Regular

(b) Non-regular

(c) Finite language

(d) None of these

10. Left hand side of a production in CFG consists of :

(a) One terminal

(b) One non-terminal

(c) More than one terminal

(d) Terminal and non-terminal