BRAINWARE UNIVERSITY

Course –MCA

Formal Language and Automata Theory (MCA203)

(Semester – 2)

Time allotted: 3 Hours **Full Marks: 70**

[The figure in the margin indicates full marks. Candidates are required to give their answers in their own words as far as practicable.]

Group –A

(Multiple Choice Type Questions) 10 x 1 = 10

1. *Choose the correct alternative from the following*

(i) The output of a Mealy 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

(ii) An FSM

a. Can recognize only natural language such as Hindi
b. Can recognize all types of languages
c. Cannot recognize any language
d. Can recognize only regular language

(iii) Let R_1 and R_2 be the two regular expression over $\sum$ representing the languages L_1 and L_2 respectively. Which of the following statement is false?

a. L1 is a regular language
b. (R1)* is a regular expression
c. $\sum$*-$(L_1 \cup L_2)$is not a regular language
d. $\sum$*-$(L_1 \cup L_2)$is a regular language

(iv) Which of the following regular expression represents the language L={a^{2n} | n>=0} ?

a. (aa)*
b. a*
c. aa*a
d. a*a*

(v) The Regular set denoted by the regular expression (a+b)(a+b) is

a. {a,b}
b. {a,b,ab,ba}
c. {aa,ba}
d. {aa,ab,ba,bb}

(vi) The string generated by the grammar S → aS | bA, A → d | ccA is

a. aaabd
b. Bbbddd
c. accdd
d. dad

(vii) A pumping lemma is used for proving that

a. a language is recursively enumerable
b. a language is not regular
c. two regular sets are equivalent
d. a language is natural

(viii) The language accepted by finite automata is

a. Type 0
b. Type 1
c. Type 2
d. Type 3

(ix) The language $L\{a^nb^n \mid n>=1\}$

a. cannot be accepted by PDA
b. can be accepted by a PDA of null store type only
c. can be accepted by a PDA of final state only
d. can be accepted by using (b) and (c)

(x) For the standard Turing Machine

a. $\sum = \Gamma$
b. $\Gamma \subseteq \sum$
c. $\sum \subseteq \Gamma$
d. $\sum$ is a proper subset of Γ

Group – B

(Short Answer Type Questions) 3 x 5 = 15

Answer any *three* from the following

2. What do you meant by Deterministic Finite Accepter? Find a deterministic finite accepter that recognizes the set of all strings on $\sum=\{a,b\}$ which contains even number of a's and odd number of b's. [2+3]
3. Prove that there exists an algorithm for determining whether a regular language, given in standard representation, is empty, finite or infinite. [5]
4. Write a brief note on Chomsky classification of grammars. [5]
5. What do you meant by Mealy Machine? Design a Mealy Machine which performs the addition of two n bit binary number. [2+3]
6. Find the highest type number which can be applied to the following productions:
   $S \rightarrow Aa$, $A \rightarrow c \mid Ba$, $B \rightarrow abc$ [5]

Group – C

(Long Answer Type Questions) 3 x 15 = 45

Answer any *three* from the following

7. (a) Show that the family of regular languages is closed under differences. [5]
   (b) Explain the Pumping Lemma in the context of Regular Language. [5]
   (c) Using Pumping Lemma show that $L=\{a^nb^n \mid n>=0\}$ is not regular. [5]

8. (a) The nor of two languages is nor(L_1,L_2)={w: $w \notin L_1 amdw \notin L_2$}. Show that the family of regular languages is closed under the nor operation. [10]

   (b) Find DFA that accepts the following language. L(aa*+aba*b*) [5]

9. (a) Explain the different types of methods of acceptance by Push Down Automata. [5]

   (b) Construct a Push Down Automata accepting $\{a^{m+n}b^mc^n \mid m,n>=1\}$ by Final state. [10]

10. (a) Describe Turing Machine with example. [5]

    (b) Design a Turing Machine over {1,b} which can compute concatenation function over Σ={1} . If a pair of words (w_1,w_2) is the input, the output has to be w_1w_2. [10]

11. (a) What do you meant by Countable Set? [3]

    (b) Prove that the set of all Turing machines are countable set. [6]

    (c) Design a Turing Machine that computes x+y where x and y are two given positive integers represented by unary symbols. [6]