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# MCS-E13/MCA-E4

## Formal Languages and Automata

### (MCA)

4th Semester Examination, 2024 (June)

Time : 2:00 Hrs.                    Max. Marks : 70

*Note* :– This paper is of Seventy (70) marks divided into Two (02) Sections 'A' and 'B'. Attempt the questions contained in these Sections according to the detailed instructions given therein. ***Candidates should limit their answers to the questions on the given answer sheet. No additional (B) answer sheet will be issued.***

### Section–A

#### (Long Answer Type Questions)     2×19=38

*Note* :– Section 'A' contains Five (05) Long-answer type questions of Nineteen (19) marks each. Learners are required to answer any *two* (02) questions only.

1. (a) Define the following terms :

   (i) Union of two languages

   (ii) Intersection of two language

   (iii) Star closure of a language

   (iv) Positive of a language

   (v) Reversal of a language (10)

   (b) Define the grammar of formal languages with the help of a suitable example. (9)

2. (a) Define a deterministic finite automaton with the help of a suitable example. (10)

   (b) Reduce the following DFA into a minimal state DFA : (9)
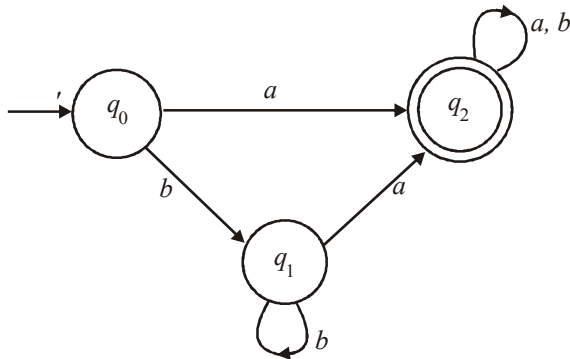


3. (a) Define Moore machine with the help of a suitable example. (10)

(b) Define a deterministic pushdown automaton. (9)

4.  (a) Let $\Sigma = (0, 1\}$. Design a pushdown automaton that accepts the language : (10)

$$L = \{0^n 1^n : n \geq 0\}$$

(b) Describe Turing machine and explain how it works. (9)

5.  (a) Explain Chomsky hierarchy with the help of suitable examples. (10)

(b) Describe post correspondence problem with the help of a suitable example. (9)

## Section–B

## (Short Answer Type Questions) 4×8=32

*Note* :– Section 'B' contains Eight (08) Short-answer type questions of Eight (08) marks each. Learners are required to answer any *four* (04) questions only.

1.  Let $\Sigma = \{a, b\}$, then design a DFA that accepts all the strings that starts with ab and terminates in baa.

2.  Describe a regular expression with the help of suitable example.

3. Define derivation tree for context free grammar with the help of a suitable example.

4. Discuss pumping lemma for regular languages.

5. Describe recursive languages and discuss the halting problem of Turing machine.

6. Discuss context sensitive language and linear bounded automaton.

7. Describe Chomsky normal form (CNF). Reduce the following grammar into CNF.

   $S \rightarrow aAD, A \rightarrow bAB.A \rightarrow aB, B \rightarrow b, D \rightarrow d$

8. What do you mean by $\lambda$-transitions in NFA ? Differentiate between NFA and DFA.

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