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17CS54

Fifth Semester B.E. Degree Examination, Feb./Mar. 2022 Automata Theory and Computability

Time: 3 hrs.

Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

- Define strings language and automata with examples. (05 Marks)
 - Define DFSA. Design DFSA to accept each of the following languages:
 - $L = \{w \in \{0, 1\}^* : w \text{ corresponds to the binary encoding, without leading 0's, of natural numbers that are evenly divisible by 4}\}$.
 - $L = \{w \in \{a, b\}^* : (\#_a(w) + 2 - \#_b(w)) \equiv_5 0\}$. ($\#_a(w)$ is the number of a's in w).
 - Differentiate Moore machines and Mealy machines. (03 Marks)

OR

- Define NDFSA. Convert the following NDFSA to its equivalent DFSA. Refer Fig.Q.2(a). (12 Marks)

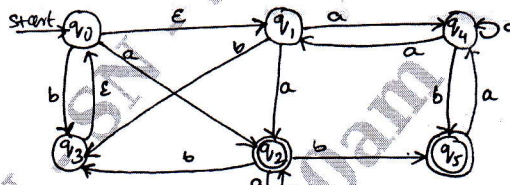


Fig.Q2(a)

- Let M be the following DFSA. Use min DFSA to minimize M . Refer Fig.Q.2(b). (08 Marks)

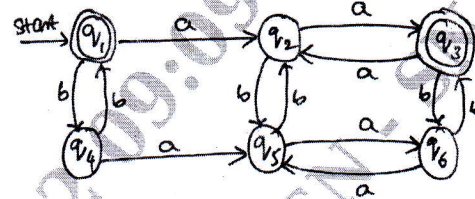


Fig.Q.2(b)

Module-2

- Define regular expression and write regular expressions for the following languages:
 - $L = \{w \in \{a, b\}^* : |w| \text{ is even}\}$
 - $L = \{w \in \{0, 1\}^* : w \text{ corresponds to the binary encoding, without leading 0's, of natural numbers that are powers of 4}\}$
 - $L = \{a^n b^m c^p | n \leq 4, m \geq 2, p \leq 2\}$
 - Build a regular expression equivalent to DFSA given below. Refer Fig.Q.3(b). (05 Marks)

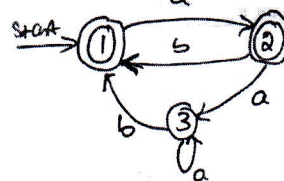


Fig.Q.3(b)

- Build a FSM that accepts the language defined by regular expression : $(b \cup ab)^*$ (05 Marks)

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg. 42+8 = 50, will be treated as malpractice.

OR

- 4 a. Define regular grammar, and show a regular grammar for the language:
 $L = \{w \in \{a, b\}^* : |w| \text{ is even}\}$ (06 Marks)
- b. State and prove the pumping theorem for regular languages. (08 Marks)
- c. Show that the language $L = \{a^n b^n | n \geq 0\}$ is not regular. (06 Marks)

Module-3

- 5 a. Define Context Free Grammar. Design a CFG for each of the following languages:
 i) $L = \{a^n b^{n+2} | n \geq 0\}$
 ii) $L = \{a^i b^j c^k | j = i + k, \forall i, j, k \geq 0\}$
 iii) $L = \{a^n b^m | m \geq n, m - n \text{ is even}\}$ (10 Marks)
- b. Convert the following grammar to Chomsky normal form:
 $S \rightarrow aACa$
 $A \rightarrow B|a$
 $B \rightarrow C|c$
 $C \rightarrow cC|\epsilon$ (10 Marks)

OR

- 6 a. Define PDA. Obtain a PDA to accept the language
 $L = \{a^n b^m a^n | n, m \geq 0 \text{ and } m \text{ is even}\}$ (10 Marks)
- b. Convert the following CFG to PDA:
 $E \rightarrow E + T | T$
 $T \rightarrow T * F | F$
 $F \rightarrow (E) | id$ (06 Marks)
- c. When a PDA is called as deterministic PDA? (04 Marks)

Module-4

- 7 a. State and prove pumping theorem for CFL. (08 Marks)
- b. Show that the following language is not context free
 $L = \{a^n b^n c^n | n \geq 0\}$ (06 Marks)
- c. Prove that context free languages are closed under Union and concatenation. (06 Marks)

OR

- 8 a. With a neat block diagram, explain the working of basic model for Turing machine. (06 Marks)
- b. Design a Turing machine that accepts $L = \{0^n 1^n | n \geq 0\}$. Draw the transition diagram and show the moves for the string 0011. (10 Marks)
- c. Briefly discuss the techniques for Turing machine construction. (04 Marks)

Module-5

- 9 a. With a neat diagram, explain the model of linear bounded automation. (08 Marks)
- b. Explain working of multitape turning machine. (06 Marks)
- c. Explain how a post correspondence problem can be treated as a game of dominoes. (06 Marks)

OR

- 10 Write short notes on the following:
 a. Quantum computation and quantum computers (10 Marks)
- b. Church – Turing Thesis (05 Marks)
- c. The post-correspondence problem. (05 Marks)
