

CBCS SCHEME

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15CS54

Fifth Semester B.E. Degree Examination, Jan./Feb. 2023 Automata Theory and Computability

Time: 3 hrs.

Max. Marks: 80

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

Module-1

- 1 a. Explain the different functions performed on strings with example. (05 Marks)
- b. Define DFSM. Construct the DFSM for the language $L = \{w : w \text{ is the string representing floating numbers}\}$. (05 Marks)
- c. Draw a DFA to accept strings of a's and b's such that:
 - (i) Language has even number of a's and odd number of b's. (06 Marks)
 - (ii) Language has not more than three a's.

OR

- 2 a. Convert the following NDFSM to DFSM:

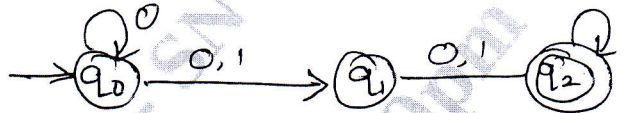


Fig.Q2(a)

(06 Marks)

- b. Minimize the following DFSM:

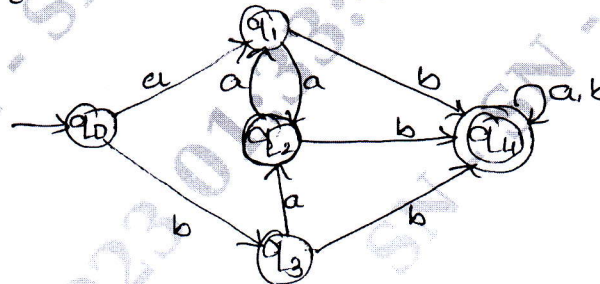


Fig.Q2(b)

(06 Marks)

- c. Define Moore machine and Mealy machine. (04 Marks)

Module-2

- 3 a. Define Regular Expression Work the RE for the languages.
 - $L = \{a^n b^m : (m + n) \text{ is even}\}$
 - $L = \{\text{String of a's and b's whose 3}^{\text{rd}} \text{ symbol from right is a}\}$(06 Marks)
- b. Build a regular expression from an FSM.

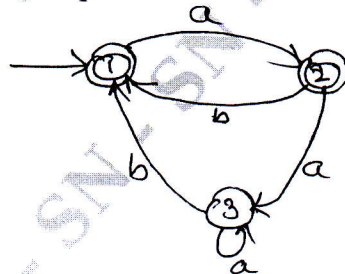


Fig.Q3(b)

(06 Marks)

- c. Convert regular expression $(a + b)^* b(a + b)$ to NDFSM.

(04 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. State and prove the pumping lemma for regular languages. (06 Marks)
 b. Show that the $L = \{a^n : n \text{ is prime}\}$ is not a regular. (04 Marks)
 c. Prove that regular language are closed under complement, intersection, difference reverse and letter substitution. (06 Marks)

Module-3

- 5 a. Define Context Free Grammar. Write the grammar for balanced parentheses. (04 Marks)
 b. When a grammar is said to be ambiguous, show that expression grammar is ambiguous. Write unambiguous grammar for the same. (08 Marks)
 c. Eliminate ϵ -rules from the given grammar.
 $S \rightarrow aTa$
 $T \rightarrow ABC$
 $A \rightarrow aA|C$
 $B \rightarrow Bb|C$
 $C \rightarrow C|\epsilon$ (04 Marks)

OR

- 6 a. Define Push Down Automata. Construct the PDA for $L = \{a^n b^{2n} : w \in \{a, b\}^*\}$. Write transition diagram. Test that the "aaabbbbb" string is accepted by the model or rejected by the model. (08 Marks)
 b. Convert the following grammar to CNF:
 $S \rightarrow aACa$
 $A \rightarrow B|a$
 $B \rightarrow C|c$
 $C \rightarrow cC|\epsilon$ (08 Marks)

Module-4

- 7 a. Prove that Content Free Languages are closed under union, concatenation, Kleene star, reverse and letter substitution. (08 Marks)
 b. Show that the $L = \{a^n b^n c^n : n \geq 0\}$ is not a Content Free Language. (08 Marks)

OR

- 8 a. With a neat diagram, explain the working of Turing Machine. (04 Marks)
 b. Explain different techniques for turing machine construction. (04 Marks)
 c. Design a turing machine M to recognize the language $\{1^n 2^n 3^n \mid n \geq 1\}$ (08 Marks)

Module-5

- 9 a. Explain the variant turing machine models in detail. (08 Marks)
 b. Explain the working of linear bounded automation. (08 Marks)

OR

- 10 Write short notes on the following:
 a. Decidable and undecidable language
 b. Halting problem of turing machine
 c. Quantum computers
 d. Church Turing Thesis (16 Marks)