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Fifth Semester B.E. Degree Examination, July/August 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

- a. Define the following terms with an example i) Alphabet ii) Power of an alphabet iii) String iv) String concatenation v) language. (05 Marks)
 - b. Explain the hierarchy of language classes in automata theory with diagram. (05 Marks)
 - c. Design DFSM for each of the following language.
 - i) $L = \{\omega \in \{0,1\}^* : \omega \text{ does not end in } 01\}$
 - ii) $L = \{ \omega \in \{a,b\}^* : \text{ every a in } \omega \text{ is immediately preceded and followed by b} \}.$

(10 Marks)

OR

a. Use MiNDFSM algorithm to minimize M given in Fig Q2(a)

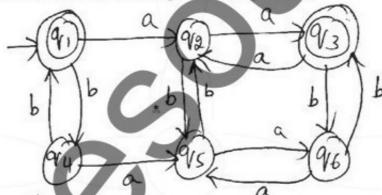


Fig Q2(a)

(08 Marks)

b. Convert the following NDFSM given in Fig Q2(b) to its equivalent DFSM.

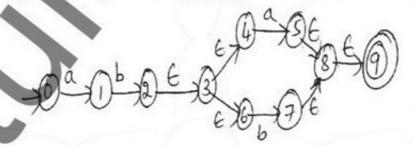


Fig Q2(b)

(08 Marks)

c. Design a mealy machine that takes binary number as input and produces 2's complement of the number as output. (04 Marks)

Module-2

- 3 a. Define Regular expression. Write regular expression for the following language.
 - L = $\{0^n 1^m | m \ge 1, n \ge 1, mn \ge 3\}$
 - ii) L = {ω∈ {a, b} ": string with atmost one pair of consecutive a's}

(08 Marks)

b. Obtain NDFSM for the regular expression (a^{*} ∪ab) (a ∪ b)^{*}.

(05 Marks)

1 of 3

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c. Build a regular expression for the given FSM in Fig Q3(c).

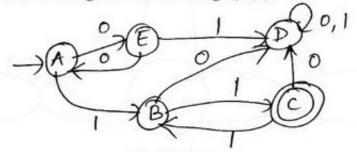


Fig Q3(c)

(07 Marks)

OR

- a. State and prove pumping Lemma theorem for regular language.
 b. Prove that regular languages are closed under complement.
 (08 Marks)
 (05 Marks)
 - c. Write regular expression, regular grammer and FSM for the languages
 L = {ω∈ {a, b}* : w ends with pattern aaaa}.

 (07 Marks)

Module-3

- 5 a. Define Context Free Grammer (CFG). Write CFG for the following languages $L = \{0^m \ 1^m \ 2^n : m \ge 1, n \ge 0\}.$ (05 Marks)
 - b. What is ambiguity in a grammar? Eliminate ambiguity from balanced parenthesis grammar? (08 Marks)
 - c. Simplify the grammar by removing productive and unreachable symbols

 $S \rightarrow AB|AC$

 $A \rightarrow aA b \in$

 $B \rightarrow bA$

 $C \rightarrow bCa$

 $D \rightarrow AB$

(07 Marks)

OR

- 6 a. Define PDA and design PDA to accept the language by final state method. (07 Marks) $L(M) = \{ \omega C \omega^R \mid \omega \in (a \cup b) \text{ and } \omega^R \text{ is reverse of } \omega \}$
 - b. Convert the following grammar to CNF

 $S \rightarrow ASB | \in$

 $A \rightarrow a AS | a$

 $B \rightarrow SbS|A|bb$

(08 Marks)

c. Consider the grammar

 $E \rightarrow E + E|E * E|(E)|id$

Construct LMD, RMD and parse tree for the string (id + id * id).

(05 Marks)

Module-4

- a. Define Turing Machine (TM). Design a TM for language
 L = {0ⁿ 1ⁿ | n ≥ 1}. Show that the string 0011 is accepted by ID.
 - b. Explain multiple TM with a neat diagram.c. Explain any two techniques for TM construction.

(10 Marks) (05 Marks)

(05 Marks)

2 of 3

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- a. Design a TM for the language $L = \{1^n 2^n 3^n \mid n \ge 1\}$ show that the string 11 2233 is accepted (12 Marks)
 - b. Demonstrate the model of Linear Bounded Automata (LBA) with a neat diagram. (08 Marks)

Module-5

- Show that A_{DFA} is decidable.
 - (05 Marks) b. Define Post Correspondence Problem (PCP). Does the PCP with two list x (b, bab3, ba) $y = (b^3, ba, b)$ have a solution. (08 Marks)
 - c. Explain quantum computation.

(07 Marks)

OR

- 10 a. Prove the A_{TM} is undecidable. (05 Marks)
 - b. Does the PCP with two list x = (0, 01000, 01) y = (000, 01, 1) have a solution. (05 Marks)
 - c. State and explain Church Turning Thesis in detail.

(10 Marks)