

# CBCS SCHEME

18CS54

## 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

- 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 DFMSM for each of the following language. (10 Marks)
  - i)  $L = \{\omega \in \{0,1\}^* : \omega \text{ does not end in } 01\}$
  - ii)  $L = \{\omega \in \{a,b\}^* : \text{every } a \text{ in } \omega \text{ is immediately preceded and followed by } b\}$ .

OR

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

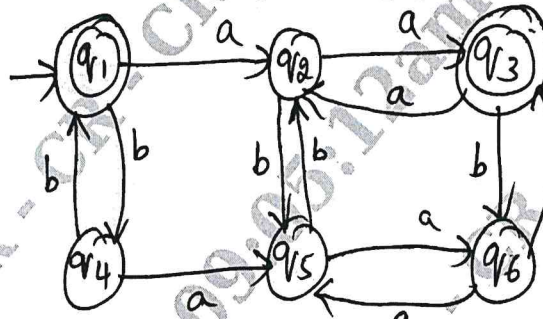


Fig Q2(a)

(08 Marks)

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

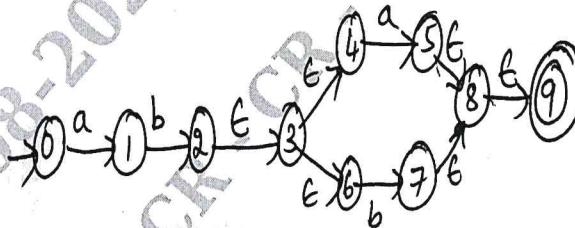


Fig Q2(b)

(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.
  - i)  $L = \{0^n 1^m \mid m \geq 1, n \geq 1, mn \geq 3\}$
  - ii)  $L = \{\omega \in \{a,b\}^* : \text{string with at most one pair of consecutive } a\text{'s}\}$  (08 Marks)
- b. Obtain NDFSM for the regular expression  $(a^* \cup ab)(a \cup b)^*$ . (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.

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

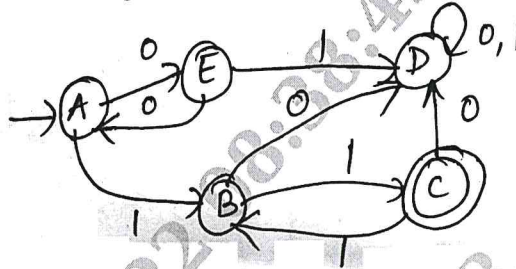


Fig Q3(c)

(07 Marks)

OR

- 4 a. State and prove pumping Lemma theorem for regular language. (08 Marks)  
 b. Prove that regular languages are closed under complement. (05 Marks)  
 c. Write regular expression, regular grammar and FSM for the languages  
 $L = \{ \omega \in \{a, b\}^* : \omega \text{ ends with pattern } aaaa \}$ . (07 Marks)

**Module-3**

- 5 a. Define Context Free Grammar (CFG). Write CFG for the following languages  
 $L = \{0^m 1^m 2^n : m \geq 1, n \geq 0\}$ . (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  
 $S \rightarrow AB|AC$   
 $A \rightarrow aA|b| \epsilon$   
 $B \rightarrow bA$   
 $C \rightarrow bCa$   
 $D \rightarrow AB$  (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  
 $S \rightarrow ASB| \epsilon$   
 $A \rightarrow aAS|a$   
 $B \rightarrow SbS|A|bb$  (08 Marks)  
 c. Consider the grammar  
 $E \rightarrow E + E \mid E * E \mid (E) \mid id$   
 Construct LMD, RMD and parse tree for the string  $(id + id * id)$ . (05 Marks)

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**Module-4**

- 7 a. Define Turing Machine (TM). Design a TM for language  
 $L = \{0^n 1^n \mid n \geq 1\}$ . Show that the string 0011 is accepted by ID. (10 Marks)  
 b. Explain multiple TM with a neat diagram. (05 Marks)  
 c. Explain any two techniques for TM construction. (05 Marks)

OR

- 8 a. Design a TM for the language  $L = \{1^n 2^n 3^n \mid n \geq 1\}$  show that the string 112233 is accepted by ID. (12 Marks)
- b. Demonstrate the model of Linear Bounded Automata (LBA) with a neat diagram. (08 Marks)

**Module-5**

- 9 a. Show that  $A_{DFA}$  is decidable. (05 Marks)
- b. Define Post Correspondence Problem (PCP). Does the PCP with two list  $x = (b, bab^3, ba)$   $y = (b^3, ba, b)$  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)

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