CBCS SCHEME

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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.*

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.

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 DFSM for each of the following language.

i) $L = \{\omega \in \{0,1\}^* : \omega \text{ does not end in } 01\}$

ii) $L = \{\omega \in \{a,b\}^* :$ every a in ω is immediately preceded and followed by b$\}$. **(10 Marks)**

OR

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

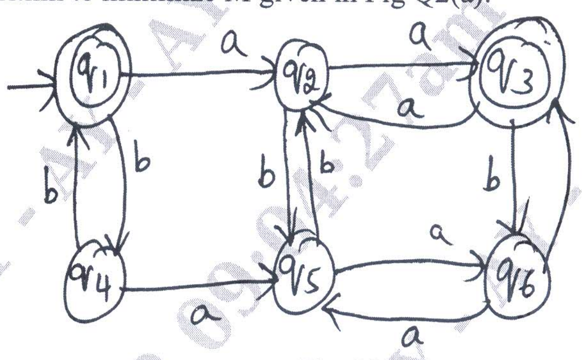

Fig Q2(a) **(08 Marks)**

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

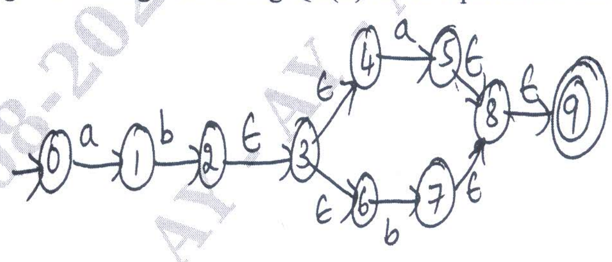

Fig Q2(b) **(08 Marks)**

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) $L = \{\omega \in \{a, b\}^* :$ string with atmost one pair of consecutive a's$\}$ **(08 Marks)**

b. Obtain NDFSM for the regular expression $(a^* \cup ab)(a \cup b)^*$. **(05 Marks)**

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

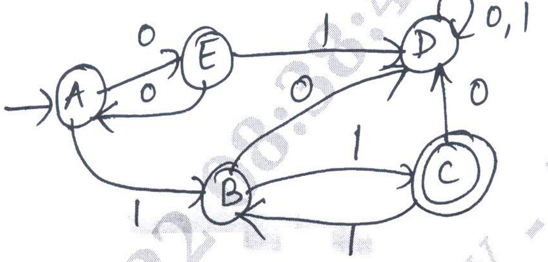

Fig Q3(c) **(07 Marks)**

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 grammer and FSM for the languages
$L = \{ \omega \in \{a, b\}^* : w \text{ ends with pattern aaaa}\}$. **(07 Marks)**

Module-3

5 a. Define Context Free Grammer (CFG). Write CFG for the following languages
$L = \{0^m 1^m 2^n : m \geq 1, n \geq 0\}$. **(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
$S \rightarrow AB|AC$
$A \rightarrow aA\, b|\in$
$B \rightarrow bA$
$C \rightarrow bCa$
$D \rightarrow AB$ **(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

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 11 22 33 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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