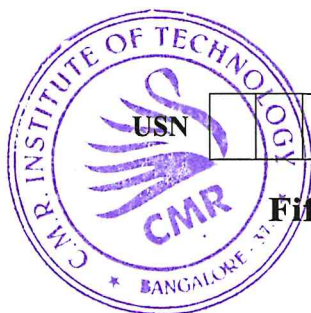


CBCS SCHEME



17CS54

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 example:
 (i) Alphabet (ii) Power of an Alphabet (iii) Language (06 Marks)
- b. Define Deterministic FSM. Draw a DFMSM to accept decimal strings which are divisible by 3. (07 Marks)
- c. Convert the following NDFSM to its equivalent DFMSM [Refer Fig.Q1(c)].

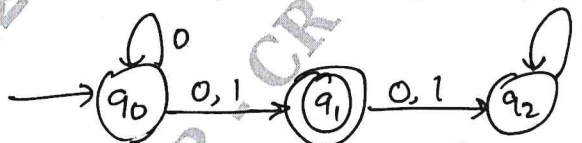


Fig.Q1(c)

Also write transition table for DFMSM.

(07 Marks)

OR

- 2 a. Minimize the following FSM [Refer Fig.Q2(a)].

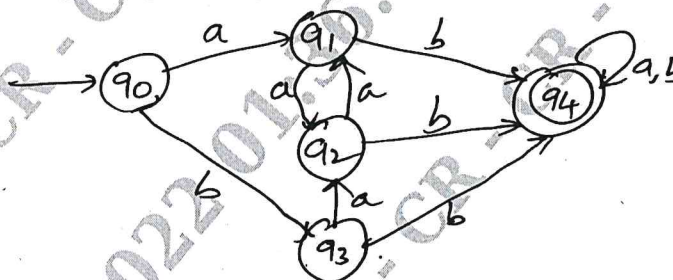


Fig.Q2(a)

(07 Marks)

- b. Construct a Melay Machine which accepts a binary number and produces its equivalent 1's complement. (07 Marks)
- c. Construct a Moore machine which accepts strings of a's and b's and count the number of times the pattern 'ab' present in the string. (06 Marks)

Module-2

- 3 a. Define Regular Expression. Obtain Regular Expression for the following :
 - (i) $L = \{ a^n b^m \mid m + n \text{ is even} \}$
 - (ii) $L = \{ a^n b^m \mid m \geq 1, n \geq 1, nm \geq 3 \}$
 - (iii) $L = \{ w \mid |w| \bmod 3 = 0 \text{ where } w \in (a, b)^* \}$
 - (iv) $L = \{ a^{2n} b^{2m} \mid n \geq 0, m \geq 0 \}$(08 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.

b. Let L be the language accepted by the following finite state machine. [Refer Fig.Q3(b)]

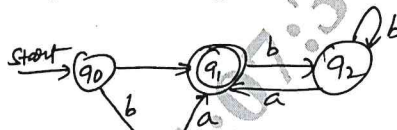


Fig.Q3(b)

Indicate for each of the following regular expression, whether it correctly describes L:

- (i) $(a \cup ba)bb^*a$
 - (ii) $(\epsilon \cup b)a(bb^*a)^*$
 - (iii) $ba \cup ab^*a$
 - (iv) $ba \cup ab^*a \cup a$
 - (v) $(a \cup ba)(bb^*a)^*$
- c. Consider the DFSM shown in below Fig.Q3(c). (05 Marks)



Fig.Q3(c)

Obtain the regular expressions $R_{ij}^{(0)}$, $R_{ij}^{(1)}$ and simplify the regular expression as much as possible. (07 Marks)

OR

- 4 a. State and prove the pumping Lemma theorem for regular language. (07 Marks)
- b. Show that the language $L = \{a^n b^n \mid n \geq 0\}$ is not regular. (07 Marks)
- c. If L_1 and L_2 are regular language then prove that $L_1 \cup L_2$, $L_1 \cdot L_2$ and L_1^* are regular languages. (06 Marks)

Module-3

- 5 a. Define CFG. Write CFG for the language
 - (i) $L = \{0^n 1^n \mid n \geq 1\}$
 - (ii) $L = \{a^n b^{n+3} \mid n \geq 1\}$(08 Marks)
- b. Consider the grammar

$$E \rightarrow + EE \mid *EE \mid - EE \mid x \mid y$$
 Find LMD and RMD for the string $+*-xyxy$ and write parse tree. (08 Marks)
- c. Is the following grammar Ambiguous?

$$S \rightarrow iC + S \mid iC + SeS \mid a$$

$$C \rightarrow b$$
(04 Marks)

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OR

- 6 a. Define PDA. Obtain PDA to accept the language $L(M) = \{w \in (a+b)^* \mid w \in w^R\}$, where w^R is reverse of w by a final state. (08 Marks)
- b. Convert the following CFG into PDA

$$S \rightarrow aABC$$

$$A \rightarrow aB \mid a$$

$$B \rightarrow bA \mid b$$

$$C \rightarrow a$$
(06 Marks)

c. Convert the following grammar into CNF:

$S \rightarrow 0A \mid 1B$

$A \rightarrow 0AA \mid 1S \mid 1$

$B \rightarrow 1BB \mid 0S \mid 0$

(06 Marks)

Module-4

- 7 a. Show that $L = \{a^n b^n c^n \mid n \geq 0\}$ is not context free. (06 Marks)
 b. Prove that CFL's are closed under union, concatenation and star operation. (06 Marks)
 c. Design a Turing Machine to accept $L = \{0^n 1^n \mid n \geq 1\}$ (08 Marks)

OR

- 8 a. Design a Turing machine to accept $L = \{a^n b^n c^n \mid n \geq 1\}$. Show the moves made by TM for the string aabbcc. (10 Marks)
 b. Explain with neat diagram, the working of a Turing machine model. (05 Marks)
 c. Write a note on Multitape turing machine. (05 Marks)

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Module-5

- 9 a. Design a turing machine to accept the language $L = \{0^n 1^n \mid n \geq 1\}$. Draw the transition diagram. Show the moves made by this machine for the string 000111. (12 Marks)
 b. Write short notes on :
 (i) Post correspondence problem
 (ii) Linear bounded automata. (08 Marks)

OR

- 10 Write short notes on:
 a. Church turing thesis
 b. Quantum computers
 c. Classes of P and NP
 d. Undecidable languages (20 Marks)
