CBCS SCHEME

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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 DFSM to accept decimal strings which are divisible by 3. **(07 Marks)**

c. Convert the following NDFSM to its equivalent DFSM [Refer Fig.Q1(c)].

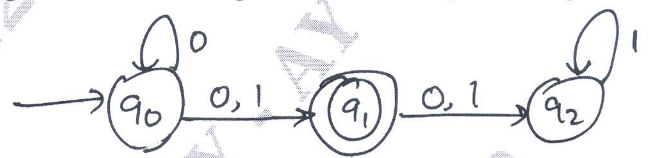

Fig.Q1(c)

Also write transition table for DFSM. **(07 Marks)**

OR

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

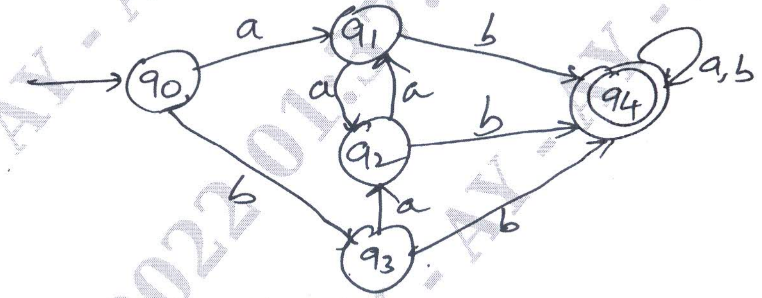

Fig.Q2(a) **(07 Marks)**

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) $L = \{ w : |w| \bmod 3 = 0 \text{ where } w \in (a, b)^* \}$
(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)]

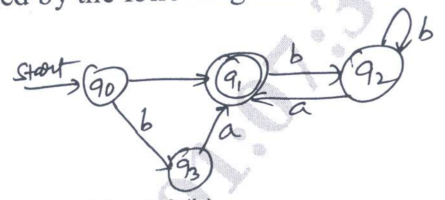

Fig.Q3(b)

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

(i) $(a \cup ba)\, bb^{*}a$

(ii) $(\in \cup b)\, a\, (bb^{*}a)^{*}$

(iii) $ba \cup ab^{*}a$

(iv) $ba \cup ab^{*}a \cup a$

(v) $(a \cup ba)\, (bb^{*}a)^{*}$ **(05 Marks)**

c. Consider the DFSM shown in below Fig.Q3(c).

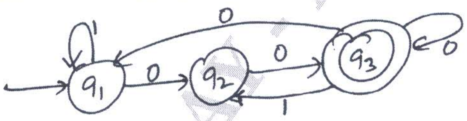

Fig.Q3(c)

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 +*– xy xy 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)**

OR

6 a. Define PDA. Obtain PDA to accept the language $L(M) = \{w \subset w^R \mid w \in (a+b)^{*}\}$, 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)

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)

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