CBCS SCHEME

USN ☐☐☐☐☐☐☐☐☐☐ **18CS54**

Fifth Semester B.E. Degree Examination, Dec.2023/Jan.2024

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. Construct the DFSM for the following languages :

(i) $L = \{W \mid W \in \{a,b\}^* \mid W$ does not contain the substring a a b$\}$

(ii) $L = \{W \mid W \in \{a,b\}^*$ where W ends either with a b or b a$\}$ **(08 Marks)**

b. Minimize the given Fig. Q1 (b) DFSM by applying min DFSM method. **(08 Marks)**

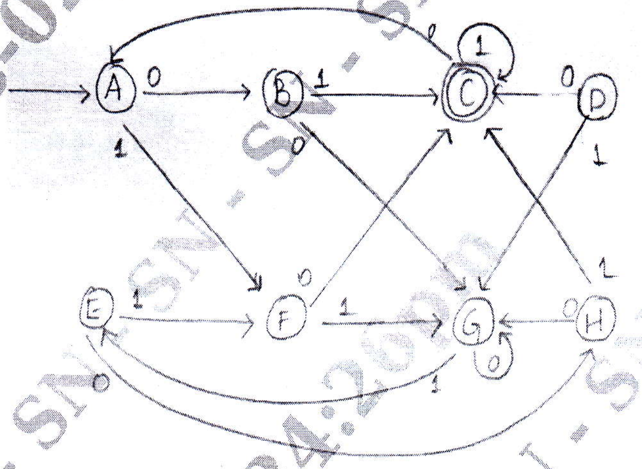

Fig. Q1 (b)

c. Explain the operations on strings and languages. **(04 Marks)**

OR

2 a. By applying ndfsm to dfsm convert the given Fig. Q2 (a) DFSM to its equivalent DFSM. **(10 Marks)**

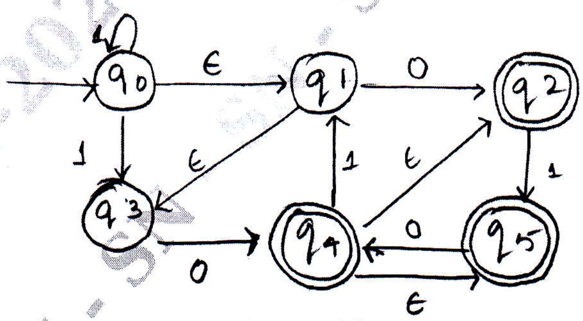

Fig. Q2 (a)

b. Construct DFSM for the language,
$L = \{W \mid W \in \{a,b\}$ where W is having even number of a's and odd number of b's$\}$ **(05 Marks)**

c. Explain the difference between DFSM and NDFSM with example. **(05 Marks)**

Module-2

3 a. Illustrate that the regular languages are closed under union, concatenation and compliment. **(10 Marks)**

b. State and prove pumping Lemma for regular languages and prove that the following languages are not regular.

(i) $L = \{a^n b^n \mid n \geq 0\}$

(ii) $L = \{WW^R \mid W \in \{a, b\}^*\}$ **(10 Marks)**

OR

4 a. Consider the FSM M given in Fig. Q4 (a). Use the fsmtoregx heuristic method to construct a regular expression that describe L(m). **(08 Marks)**

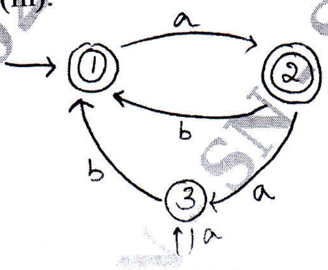

Fig. Q4 (a)

b. Write the regular expression for the following languages ;

(i) $L = \{a^{2n} b^{2m} \mid n \geq 0, m \geq 0\}$

(ii) $L = \{a^n b^m \mid m \geq 1, n \geq 1, n + m \geq 3\}$

(iii) $L = \{W \mid W \in \{a, b\}^* \text{ and } |W| \text{ is multiples of } 3\}$. **(06 Marks)**

c. Draw a FSM for the given below regular expressions :

(i) $(0 + 1)^* o (0 + 1)^* o$

(ii) $ab(a + b)^* a$ **(06 Marks)**

Module-3

5 a. Obtain a context free Grammar for the language :

(i) $L = \{0^{2n} 1^m \mid n \geq 0, m \geq 0\}$

(ii) $L = \{0^i 1^j 2^k \mid i = j \text{ or } j = k\}$, i, j, k ≥ 0 **(04 Marks)**

b. Convert the following CFG into CNF :

$R = \{ A \rightarrow a \qquad B \rightarrow b \mid bR$

$A \rightarrow aB \qquad C \rightarrow C \mid cC$

$A \rightarrow BaC$

$A \rightarrow BbC$

$\}$ where A is the start symbol **(06 Marks)**

c. Design a PDA to accept the language $L = \{a^n b^n \mid n \geq 0\}$, draw the transition diagram and show the string acceptance for W=aaabbb. **(10 Marks)**

OR

6 a. What is ambiguous grammar? Prove that the given grammar is ambiguous : $S \rightarrow (S) \mid S S \mid \in$ **(06 Marks)**

b. Design a PDA for the language $L = \{WCW^R \mid W \in \{a, b\}^*\}$ and draw the transition diagram and show the string acceptance for W = a a b c b a a. **(10 Marks)**

c. Convert the following CFG to CNF
$R = \{ S \rightarrow XY$
$X \rightarrow A$
$A \rightarrow B/a$
$Y \rightarrow bT$
$T \rightarrow Y/C$
$\}$
(04 Marks)

Module-4

7 a. Design a Turing Machine to accept $L = \{0^n 1^n 2^n \mid n \geq 0\}$. Draw the transition diagram and show the moves made for the string $W = a\,a\,b\,b\,c\,c$. **(10 Marks)**

b. Explain multitape Turing machine and prove that language accepted by multitape turing machine is also accepted by singletape turing machine. **(10 Marks)**

OR

8 a. Explain non-deterministic turing machine and prove that there exists equivalent DTM. **(10 Marks)**

b. Design a Turing machine for the language, $L = \{W \mid W \in \{a,b\}^*$ where W is a string of palindrome of $\mid$ odd or even length$\}$. Draw the transition diagram. Show the string acceptance for W = ababa. **(10 Marks)**

Module-5

9 a. Explain post correspondence problem. **(07 Marks)**

b. Explain Halting problem in Turing machine. **(06 Marks)**

c. Explain recursively enumerable language. **(07 Marks)**

OR

10 Write short notes on :

a. Growth rate of function.
b. Classes of P & NP
c. Quantum computers.
d. Church Turing Thesis

(20 Marks)

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