USN

15CS54

Fifth Semester B.E. Degree Examination, July/August 2022
Automata Theory and Computability

Time: 3 hrs.

Max. Marks: 80

Note: *Answer any FIVE full questions, choosing ONE full question from each module.*

Module-1

1   a.   List the applications of Finite Automata. Design DFSM for following languages.
     i) $L = \{W \mid |n_0| \bmod_2 = 0 \ \& \ |n_1| \bmod 3 = 0\}$.
     ii) $L = \{$strings of a's and b's which start with ab and ends with a$\}$. **(10 Marks)**
    b.   Define Finite State Transducers. Obtain and equivalent Moore machine for the Mealy machine given below. **(06 Marks)**

Fig. Q1(b)
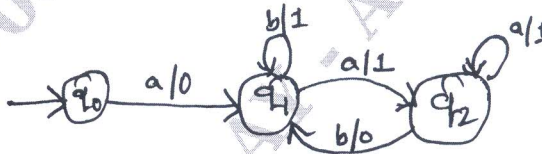
OR

2   a.   Define Power of an Alphabet. Consider the DFSM given below with accepting states (D, F, G) and compute. **(08 Marks)**

δ	0	1
A	B	C
B	D	E
C	F	G
*D	D	E
E	F	E
*F	D	E
*G	F	G

     i)   Distinguishable & Equivalent States   ii)   Minimization of Finite State Machine.
    b.   Define eps ( ). Obtain an equivalent DFSM for Finite Automata given below. **(08 Marks)**

Fig. Q2(b)

Module-2

3   a.   Define Regular Expression. Construct the Regular expression for the languages given below
     i) $L = \{a^n b^m \mid n, m \geq 1, mn \geq 3\}$ ii) $L = \{a^n b^m \mid m + n \text{ is even}\}$
     iii) $L = \{$Strings of 0's & 1's which does not contain two consecutive 0's and ends with 0$\}$. **(08 Marks)**
    b.   State and prove the pumping Lemma for Regular Languages. Prove that, the language $L = \{a^n b^m c^n \mid n, m \geq 0\}$ is not regular. **(08 Marks)**

OR

4 a. Obtain Regular expression for Finite State Machine given below and give the language defined by Regular expression. **(08 Marks)**

Fig. Q4(a)

b. List the closure properties of Regular Languages construct the Regular Grammar for following : i) $L = \{(01)^* 101 (0+1)^*\}$ ii) $L = \{a^{n+1} b^{2m+1} \mid n, m \geq 0\}$ iii) $L = \{(01+1)^* (0+10)^*\}$. **(08 Marks)**

Module-3

5 a. Define CFG. Construct CFG for the languages given below :
   i) $L = \{W \mid n_a(W) = n_b(W)\}$ ii) $L = \{a^{2n+1} b^m c^m c^{2n} \mid n, m \geq 0\}$. **(08 Marks)**

   b. Define CNF. Design PDA for the language $L = \{0^n b^m 1^{2n} \mid n, m \geq 0\}$. Write the Instantaneous Description for the string 0bb11. **(08 Marks)**

OR

6 a. Consider the Grammar
   $E \rightarrow E + E \mid E - E \mid E * E \mid E/E \mid (E) \mid I$
   $I \rightarrow 0 \mid 1 \mid a \mid b \mid Ia \mid Ib \mid I0 \mid I1$
   and compute the following for input string $(a1 + b0 * 00)$.
   i) LMD   ii) RMD   iii) Parse Tree   iv) Is this ambiguous? Justify your answer. **(08 Marks)**

   b. List out the simplification techniques of CFG. Explain PDA and obtain an equivalent PDA for CFG given below : $S \rightarrow a \mid b \mid aSb \mid bSa$. **(08 Marks)**

Module-4

7 a. List the Closure properties of CFLs and prove that language $L = \{a^{2n} b^n c^{2n} \mid n \geq 0\}$ is not context free language. **(08 Marks)**

   b. Define TM. Explain working of TM with neat diagram. **(08 Marks)**

OR

8 a. Design and construct TM to accept the language $L = \{W \mid W$ is balance parenthesis$\}$. Show the moves made by TM for string $W = (\,(\,)\,(\,)\,)$. **(08 Marks)**

   b. List the techniques for TM construction. Explain the concept of string membership in CFL using context free grammar and Push Down Automata. **(08 Marks)**

Module-5

9 a. List the variants of TM. Prove that for every language accepted by multi tape TM is accepted by some Single tape TM. **(08 Marks)**

   b. Define Linear Bounded Automata (LBA). Explain the model of LBA with neat diagram and state the relation between LBA and context sensitive language. **(08 Marks)**

OR

10 a. State the definition of Algorithm by Church – Turing. Explain the Quantum computers. **(08 Marks)**

   b. Define P, NP classes with respect to TM. Explain post correspondence problem and prove that PCP with two list $x = (01, 1, 1)$; $y = (01^2, 10, 1^1)$ has no solution. **(08 Marks)**

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