USN _____   18CS54

Fifth Semester B.E. Degree Examination, Feb./Mar. 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 examples :
          i) Alphabet   ii) String   iii) Language   iv) Concatenation at Languages
          v) Power of an Alphabet.   (10 Marks)
     b.   Define DFSM. Design DFSM
             i) To accept strings having Even number of a's and even number b's
             ii) To accept binary numbers divisible by 5.   (10 Marks)

OR

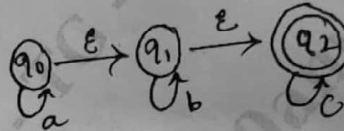2   a.   Convert the following NDFSM of DFSM. [Refer Fig Q2(a)].

Fig Q2(a)   (08 Marks)

     b.   Minimize the following DFSM by indentifying Distinguishable and Non-distinguishable states.

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

(12 Marks)

Module-2

3   a.   Define Regular Expression. Write RE for the following Languages.   (10 Marks)
             i) Strings of 0's and 1's ending with three consecutive zeroes.
             ii) Strings of a's and b's having substring aa.
     b.   Write DFSM to accept intersection of Languages $L_1 = (a + b)^*a$ and $L_2 = (a + b)^*b$ (10 Marks)

OR

4   a.   Using Kleen's theorem, prove that for any Regular Expression R, their exits a finite automata $M = (Q, \Sigma, \delta, q_0, F)$ which accepts L(R).   (10 Marks)
     b.   State and prove pumping Lemma for Regular Languages. Show that the Language $L = \{ww' : w \in (0, 1)^*\}$ is not regular.   (10 Marks)

Module-3

5   a.   Define Context Free Grammar. Design CFG for the following Languages.
         i) $L_1 = \{w : |w| \text{ Mod } 3 = 0\}$ over $\Sigma = \{a\}$
         ii) $L_2 = \{a^n b^m c^k : m = n + k\}$ over $\Sigma = \{a, b, c\}$ (10 Marks)

    b.   Define Ambiguity. Consider the grammar
         $E \to E + E \mid E * E \mid (E) \mid id$
         Find Leftmost and Rightmost derivations and parse tree for the string id + id * id, show that the grammar is ambiguous.   (10 Marks)

OR

6   a.   What is Chomsky Normal Form of CFG? Convert the following grammar to CNF.
         $S \to ABC \mid BaB$
         $A \to aA \mid BaC \mid aaa$
         $B \to bBb \mid a \mid D$
         $C \to CA \mid AC$
         $D \to \varepsilon$
         Eliminate ε - productions, Unit productions and useless symbols if any before conversion.   (10 Marks)

    b.   What is NPDA? Design NPDA for Language $L = \{a^n b^n \mid n \geq 1\}$. Draw transition diagram. Write sequence of moves made by NPDA to accept the string aaabbb.   (10 Marks)

Module-4

7   a.   Design TM for WCW^R over $\Sigma = \{0, 1\}$. Write transition diagram, and ID for w = 101C101   (14 Marks)

    b.   Explain : i) Multitape   ii) Non-deterministic TM   (06 Marks)

OR

8   a.   Define Turning Machine. Explain the working of Turning Machine.   (06 Marks)

    b.   Design Turning machine to accept the Language $L = \{0^n 1^n 2^n \mid n >= 0\}$. Draw the transition diagram. Write sequence of moves made by TM for string 001122.   (14 Marks)

Module-5

9   a.   Explain Halting problem in Turning machine.   (07 Marks)
    b.   Write applications of Turning Machine.   (06 Marks)
    c.   Explain Recursively Enumerable Languages.   (07 Marks)

OR

10 a.   Explain Quantum Computers.   (07 Marks)
    b.   Explain P and NP classes.   (07 Marks)
    c.   Explain Church Turning Thesis.   (06 Marks)

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