4E1306

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B.Tech. IV-Sem. (Main/Back) Examination, July - 2023
Computer Science and Engineering
4CS4-06 Theory of Computation
CS, IT, AID, CAI

Time : 3 Hours **Maximum Marks : 70**

Instructions to Candidates:

*Attempt **all Ten** questions from **Part A**, Attempt any **Five** questions out of **Seven** questions from **Part B** and **Three** questions out of **Five** questions from **Part C**.*

Schematic diagrams must be shown wherever necessary. Any data missing may suitably be assumed and stated clearly. Units of quantities used/calculated must be stated clearly.

Use of following supporting material is permitted during examination (As Mentioned in form No. 205).

PART - A
(Word limit 25)

All questions are **compulsory.** **(10×2=20)**

1. Give the mathematical definition of finite automaton.
2. Construct an NFA, with the specified number of states, that accepts the language {w : w ends with 10} with three states.
3. Write a regular expressions over {0,1} consisting of strings that contain exactly two 1's.
4. Prove (1+00*1)+(1+00*1)(0+10*1)* (0+10*1) = 0*1(0+10*1)*.
5. Explain why the grammar given below is ambiguous.

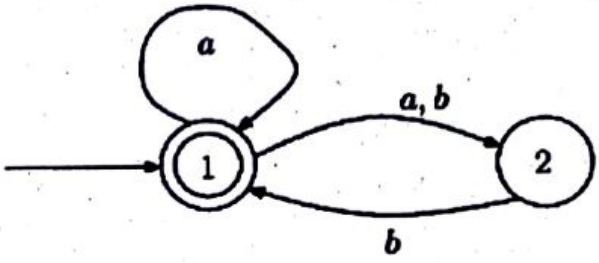
   $S \rightarrow 0A|1B, A \rightarrow 0AA|1S|1, B \rightarrow 1BB|0S|0$
6. What is difference between Finite State Automaton and Pushdown Automaton?
7. Explain the Chomsky Hierarchy in details.
8. Can all computational problems solved by computer?
9. What is Halting Problem?
10. List the problems belonging to polynomial class.

PART - B

(Word limit 100)

Attempt any **Five** questions. **(5×4=20)**

1. Convert the following NFA to an equivalent DFA.



2. Design a Mealy Machine that computes 2's complement of the given binary input number.

3. Use the pumping lemma to prove that the following languages is not regular.

   $\{a^n b^n : n \geq 0\}$

4. Let G be the grammar S->0B|1A.A->0|0S|1AA, B->1|1S|0BB.For the string 00110101, find (a) the leftmost derivation, (b) the rightmost derivation, and (c) the derivation tree.

5. Design a PDA accepting $\{a^n b^m c^n \;\; m, n \geq 1\}$ by null store

6. Consider the TM description given M as shown in table. Draw the computation sequence of the input string 00.

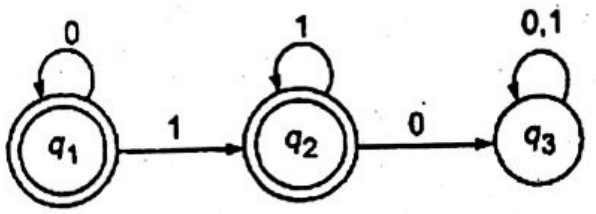
Present State	Tape symbol		
	b	0	1
$\rightarrow q_1$	$1Lq_2$	$0Rq_1$	
q_2	bRq_3	$0Lq_2$	$1Lq_2$
q_3		bRq_4	bRq_5
q_4	$0Rq_5$	$0Rq_4$	$1Rq_4$
(q_5)	$0Lq_2$		

7. Write a note on Tractable and Untractable Problems.

PART - C

Attempt any **Three** questions. **(3×10=30)**

1. Describe in English the set accepted by the finite automaton whose transition diagram is as shown in following figure.



2. Consider the context-free grammar $G = (S, \Sigma, V, P)$, where $V = \{S,B\}$, $\Sigma=\{0, 1\}$, S is the start variable, and P consists of the rules $S \rightarrow BSB|B|\varepsilon$, $B \rightarrow 00|\varepsilon$ convert this grammar to a context-free grammar in Chomsky normal form whose language is the same as that of G. Throughout the construction, upper case letters will denote variables.

3. Let $\Sigma=\{int, +, *, (,)\}$ and consider the language ARITH = $\{w \in \Sigma^* | w$ is a legal arithmetic expression$\}$ Design a PDA that accepts the int + int* int, ((int + int)*(int+int))+(int) types of arithmetic expression?

4. Design a Turing machine over {1,b} which can compute a concatenation function over $\Sigma=\{1\}$. If a pair of words $(w_1,w_2\}$is the input and the output has to be w_1w_2..

5. Explain the traveling salesperson problem? Why this problem is NP-complete?
