**Sub Code:** (CST-009) **ROLL NO……..……..**

**EVEN SEMESTER EXAMINATION, 2023 – 24**

**2nd yr B.Tech. –Computer Science&Engineering**

**FORMAL LANGUAGES & AUTOMATA THEORY**

**Duration: 3:00 hrs** **Max Marks: 100**

***Note: - Attempt all questions. All Questions carry equal marks. In case of any ambiguity or missing data, the same may be assumed and state the assumption made in the answer.***

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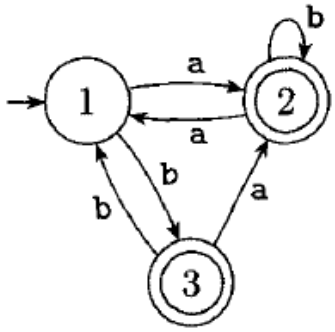
| Q 1. | Answer any four parts of the following.<br>a) Give DFAs that recognize the following languages:<br>{w Є {0,1}* \| w contains 110 as a substring}<br><br>b) Convert the following Deterministic Finite Automata into Regular Expression.<br>  <br><br><br>c) Give context-free grammars having two variables generating the following languages over the alphabet {a,b}<br>L= "The set of strings with more a's than b's"<br><br>d) State whether the statement is true or false and Briefly give reason in support of your answer. "The class of context-free languages is closed under intersection".<br><br>e) Discuss four closure properties of Regular Languages and prove that the Regular Languages are closed under them.<br><br>f) What is Pumping Lemma for regular Language. | 5x4=20 |
| Q 2. | Answer any four parts of the following.<br>(a) Put the following grammar into Chomsky Normal Form.<br>S → T \| TaS<br>T →aTb \| bTa \| TT \| Є<br><br>b) Give DFAs that recognize the following languages:<br>{w Є {0,1}* \| w contains at least two 0's}<br><br>c) State whether the statement is true or false and Briefly give reason in support of your answer: " A context free grammar G and w be a string in L(G), then the number of leaves in a parse tree of w with respect to G can be more than the length of w". | 5x4=20 |

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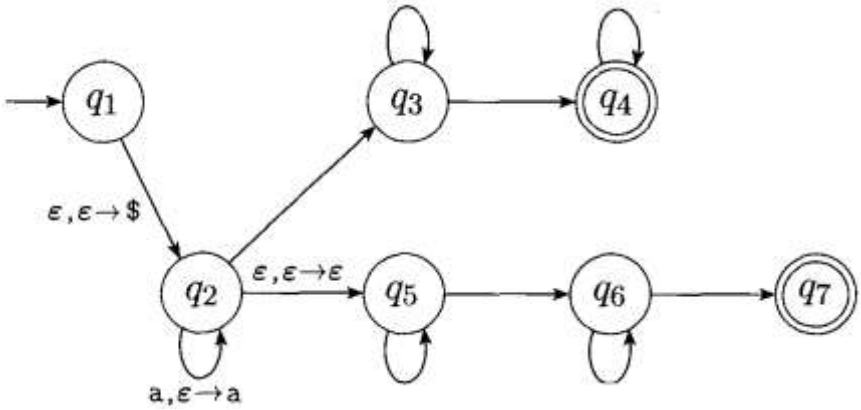
| | d) Construct a Deterministic finite automaton to accept the set *L* of all strings over {0,1} ending with 010.<br>e) Differentiate between Non deterministic finite automata (NFA) and deterministic finite automata(DFA).<br>f) What are regular expressions? Discuss in brief operators of regular expression and their precedence | |
| Q 3. | Answer any two parts of the following.<br>a) Design a non-deterministic pushdown automata M that recognizes the language L= { $ww^R$ \| w Є {0,1}*}, where $w^R$ means written backwards. Give the informal description of the PDA.<br><br>b) Design a Turing machine with no more than three states that accepts the language L(a(a+b)*). Assume that $\sum = \{a,b\}$. Is it possible to do thiswith a two state machine?<br><br>c) Elaborate Chomsky and Greibach normal forms. | 10x2= 20 |
| Q 4. | Answer any two parts of the following.<br>a) Design a Turing machine that copies strings of 1's. More precisely, find a machine that performs the computation. Give the pseudocode of the design.<br>$q_0w$ \|--*$q_fww$.<br><br>b) Complete the following state transition diagram of Push Down Automata M that recognizes<br>L= { $a^ib^jc^k$ \| i,j,k>=0 and i=j or i=k}<br>  <br><br>c) What are Recursive languages? Discuss the Properties of recursive languages. | 10x2= 20 |
| Q 5. | Answer any two parts of the following.<br>a) Find a grammar having single variable that generates the following language:<br>L = $\{a^nb^{n+1} \mid n \geq 0\}$<br>Give the complete specification of the grammar. Construct parse tree for any two strings w Є L and \|w\|=5. Show whether the grammar is ambiguous?<br><br>b) Discuss Undecidable Problems about Turing Machines.<br><br>c) Design a Turing Machine to recognize all the strings consisting of an even number of 1's. Give the idea of construction and transition table for the Turing machine. | 10x2= 20 |

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