Roll Number: _____

Thapar Institute of Engineering and Technology, Patiala

Department of Computer Science and Engineering

B E- COE, CSE (VI Semester) MAKEUP-MST	Course Code: UCS701 Course Name: Theory of Computation
April 20, 2023, 5:30 PM	
Time: 2 Hours, M. Marks: 30	Name of Faculty: Sunita Garhwal, Nitigya Sambyal, Chinmaya Panigrahy, Nidhi Kalra, Shashank Sheshar, Javed Imran.

Note: Attempt all questions with proper justification. Assume missing data, if any, suitably.

Q1. Given the regular expression $r = (a+b)^* aba$ over the alphabet $\sum = \{a,b\}$ (5)

a) Convert the given r into NFA using Thompson's construction.
b) Convert the obtained NFA into DFA using subset construction.
c) Minimize the obtained DFA in 1 (b).

Q2. Construct a deterministic finite automaton over $\sum = \{a,b\}$ such that (6)

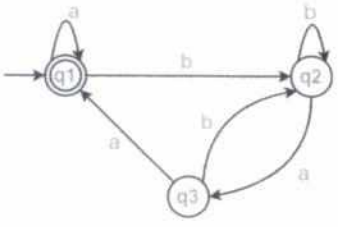
a) It recognizes the language where every a is not followed by bb?
b) It recognizes the language $L = \{vwv: v, w \in \{a, b\}^*, |v| = 2\}$
c) It recognizes the language $L = \{ab^5wb^2: w \in \{a, b\}^*\}$

Q3. a) Construct a Moore machine that takes binary number as input and produces residue '5' as output? Convert it into an equivalent Mealy machine. (3)

b) Write the regular expression corresponding to the language L where $L = \{x \mid x \in \{0,1\}^* \mid x$ ends with 1 and does not contain substring 00$\}$. (2)

c) Construct the Right Linear Grammar over the $\sum = \{a,b\}$ for representing the regular expression: $r = a(ba)^*$ (1)

Q4. a) Write down regular expression corresponding to the following finite automaton using Arden's Theorem. (3)



[P.T.O.]

b) Construct a minimum DFA with initial state as q_0 and final state as q_2 for the given transition table:

(2)

Current State	Input Symbol	
	0	**1**
q_0	q_1	q_5
q_1	q_6	q_2
q_2	q_0	q_2
q_3	q_2	q_6
q_4	q_7	q_5
q_5	q_2	q_6
q_6	q_6	q_4
q_7	q_6	q_2

(c) Construct a left linear grammar for the language $L = \{a^n b^m : n \geq 2, m \geq 3\}$ over the $\sum = \{a, b\}$ (2)

Q5. (a) Find all the strings of length 2, 3 and 4 that are not in the language represented by the regular expression a*(ab)*b* over alphabet $\sum = \{a, b\}$. (2)

(b) U sing Pumping Lemma, Prove that $L = \{w \in \Sigma^* \mid n_a(w) > n_b(w)\}$ over alphabet $\sum = \{a, b\}$ is not regular. (2)

(c) Prove that regular languages are closed under set difference. (2)

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Thapar Institute of Engineering and Technology Patiala
Computer Science and Engineering Department
End Sem Test

BE Third Year (6th Semester) 13th May, 2023 9:00AM **UCS701: Theory of Computation**
Time: 3 Hours, Max Marks:40 **Coordinators: Dr. Sunita Garhwal, Dr. Nitigya Sambyal**

Instructors: Sunita Garhwal, Nitigya Sambyal, Chinmaya Panigrahy, Nidhi Kalra, Shashank Sheshar, Javed Imran

Note: Attempt all questions with proper justification. Assume missing data, if, any, suitably.

Q1	a) Consider the following grammar G: $S \rightarrow (L) \mid a$ $L \rightarrow L,S \mid S$ Remove the left recursion from the above grammar G. b) Consider a context-free grammar G: $S \rightarrow XY$ $X \rightarrow YS \mid 1$ $Y \rightarrow SX \mid 0$ Convert the context-free grammar into Greibach Normal Form(GNF).	2+4
Q2	a) Construct a context-free grammar over {0, 1}for the languages i) L_1 = {w | w starts and ends with the same symbol} ii) L_2 = {w | length of w is odd} b) Construct deterministic finite automaton which accept a string containing "*ing*" at the end of a string over {*a-z*}, e.g., "*anything*" but not "*anywhere.*" c) Given the regular expression r = 1*(10)*1*. Convert the given r into NFA using Thompson's construction.	3+2+2
Q3	a) Draw the flowchart for the language $L=\{a^n b^{2m} c^{3m} d^p \mid n>0, m>0, p>n\}$. Write down the transition diagram for the above-designed flowchart. b) Design a CFG for the language L over *{0, 1}* to generate all strings having alternate sequence of 0 and 1.	5+2
Q4	a) Consider the CFLs $L_1=\{a^n b^n \mid n\geq 1\}$ and $L_2=\{a^p b^q \mid p,q\geq 1\}$, then intersection of L_1 and L_2 is a CFL or not. Justify your answer. b) Given the context-free grammar $S \rightarrow XY$ $X \rightarrow a \mid b \mid XA$ $Y \rightarrow a \mid AY$ $A \rightarrow a$ Apply CYK algorithm to determine whether the string *w=babaa* belongs to the language generated by the above given grammar.	2+4

[P.T.O.]

Q5	a) Prove that $L=\{a^n b^n c^n \mid n \geq 0\}$ is not context-free language using Pumping Lemma. b) Design a Mealy machine that recognises the double occurrence of symbol *'a'* in the input string $w \in \{a,b\}^*$. Show the output sequence for the string $w=aababba$. [Hint: input: *aba* then ouput: *000*, input: *aaab* then output: *0110*]	3+4
Q6	a) Design a Post machine for the language $L=\{a^n b^n \mid n \geq 0\}$. b) Write down the logic for design of a Turing machine over *{0, 1}* for the language L={w | w contains equal number of 0's and 1's in any order, and |w|>=2}. Design the Turing machine for *L*.	3+4