A 1100CST301122202 Pages: 3

Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

Fifth Semester B.Tech Degree Regular and Supplementary Examination December 2022 (2019 Scheme)

Course Code: CST 301

Course Name: FORMAL LANGUAGES AND AUTOMATA THEORY

Max. Marks: 100 Duration: 3 Hours

PART A

(Answer all questions; each question carries 3 marks)

		Marks
1	Define Ɛ-closure of a state? Explain with example.	3
2	Construct a DFA for strings in which first and last letters do not match. $\sum = \{a, b\}$	3
3	Generate regular expression for strings in which number of a's is a multiple of three. $\sum = \{a, b\}$	3
4	Explain any 3 closure properties of regular languages	3
5	With suitable example, explain about ambiguous grammar	3
6	State Myhill - Nerode Theorem	3
7	Whether DPDA and NPDA are equivalent? Justify your answer	3
8	Explain how CFGs can be converted to Chomsky Normal Form	3
9	Define Turing Machine	3
10	Differentiate between Recursive and Recursively Enumerable languages	3

PART B

(Answer one full question from each module, each question carries 14 marks)

Module -1

11	a)	Prove that, if L is accepted by an ordinary NFA, there exist an equivalent ϵ-NFA that also accepts L	7
	b)	Design an NFA (without Ɛ-moves) for strings having substring '***bab***'. Convert it into equivalent DFA. $\sum = \{a, b\}$	7
12	a)	Construct an ϵ-NFA for the language $L = \{ 0^n 1^m 2^p / n, m, p \geq 0 \}$ and convert it into equivalent NFA without ϵ-transitions	7
	b)	Design an NFA (without Ɛ-moves) for strings with either consecutive zeros or consecutive ones. Obtain its corresponding DFA	7

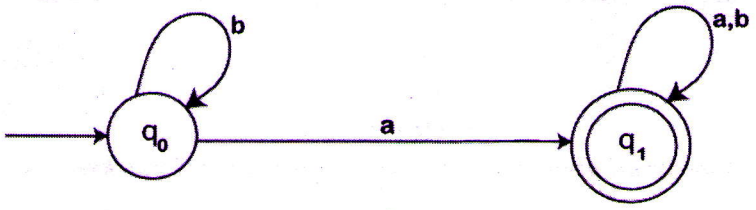
Module -2

13 a) Using pumping lemma, show that $L = \{ a^n b^n / n > 0 \}$ is not regular 7

b) Develop equivalent automata for the Regular Expression $(a+b)^*aabb(a^*+bb)^*$ 7

14 a) Prove that for every Regular Expression *'R'*, there is an ϵ-NFA *'M'* 7

b) List out the rules for writing regular expressions. Convert the following DFA to its equivalent Regular Expression



7

Module -3

15 a) What is Greibach Normal Form (GNF)? Convert the following CFG to GNF 7

S → AA / a, A → SS / b

b) a) Design CFG for the following languages

(i) Palindromes over {a, b}

(ii) Stings with more than 2 zeros. ∑ = **{0, 1}** 7

(iii) $(0+1)^*(01)^*(0+1)^*$

16 a) Minimize the following DFA using Myhill – Nerode theorem

	a	b
→q0	q1	q2
q1	q1	q3
q2	q1	q2
q3	q1	*q4
*q4	q1	q2

7

b) What is Chomsky Normal Form (CNF)? Convert the following productions to CNF. **S → aSa / bSb / SS / Ɛ** 7

Module -4

17 a) Prove that for every PDA accepted by final state, there exists an equivalent PDA accepted by empty stack. 7

b) Design PDA for set of even length palindromes over {a, b}. Illustrate the working with suitable example 7

18 a) Design PDA for $L = \{ x \in \{a, b\}^* / \#_a(x) = \#_b(x) \}$.
Here $\#_p(x)$ represents the number of occurrences of the symbol p in the string x 7

b) Using pumping lemma for CFLs, show that $L = \{ ww / w \in \{a, b\}^* \}$ is not context free. 7

Module -5

19 a) Design TM for $L = \{a^n b^m a^n / m, n > 0\}$. Illustrate the working with suitable example 7

b) Explain Chomsky hierarchy for formal languages and evaluate various types 7

20 a) Design a TM to copy a string of a's and b's to the right side, leaving one blank symbol (b) in between. Assume that initially the input tape contains **bxb** and TM halts with **bxbxb** as the tape content. $x \in \{a, b\}^*$ 7

b) Prove that TM halting problem is undecidable 7

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