Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

B.Tech Degree S5 (R, S) / S5 (PT) (R, S) Examination December 2023 (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		Draw transition diagram for NFA (without ϵ-moves) for strings starting with '10' or '11'. Σ = {0,1}.	3
2		Design a DFA for strings in which fist and last letters do not match. Σ = {a, b}.	3
3		Give a regular expression for the set of all strings not containing 101 as a Substring.	3
4		State the closure properties of regular language.	3
5		Explain with the help of example ambiguous grammar.	3
6		Write CFG equivalent to the regular expression 0*1(0+1)*+1.	3
7		What are the conditions required for push down automata to qualify as deterministic push down automata?	3
8		Can we construct a DPDA for the language ww^r? Justify your answer.	3
9		Differentiate Recursive and Recursively Enumerable Languages.	3
10		Design a TM to find the 1's complement of a binary number.	3

PART B

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

Module -1

11	a)	Construct an ϵ-NFA for the language L= $\{0^n1^m2^p / n,m,p \geq 0\}$ and convert it into equivalent DFA.	8
	b)	Design a DFA for strings in which number of a's is multiple of 3 and number of b's is multiple of 2. Σ = {a, b}.	6
12	a)	Draw the state-transition diagram showing an NFA N for the following language	7

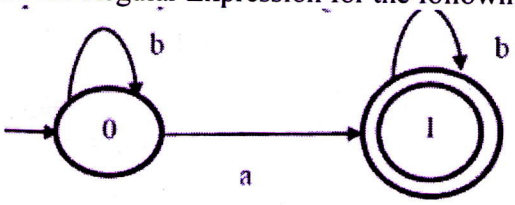
L. Obtain the DFA D equivalent to N by applying the subset construction algorithm.

L = {x ∈ {a, b} * | x contains 'bab' as a substring}.

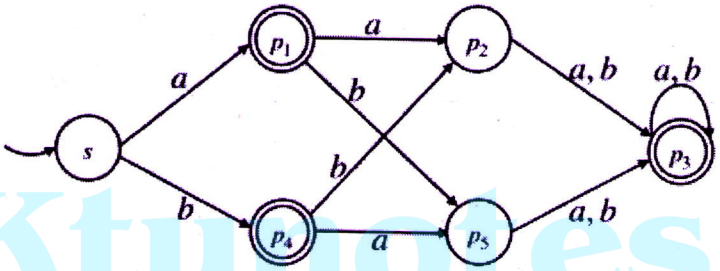
b) Construct a regular grammar for L= {0^n 11| n≥1}. Construct deterministic finite automata for the same. 7

Module -2

13 a) Find the Regular Expression for the following DFA 7



b) Obtain the minimum state DFA from the following DFA 7



14 a) Develop equivalent automata for the R.E. (ab + b)*(a+bb)*a*. 7

b) Using Pumping Lemma for regular language prove that the language L= 0^n |n is perfect square} is not regular. 7

Module -3

15 a) State Myhill- Nerode Theorem. Prove the language L={a^nb^n,where n>=1 is not Regular using Myhill-Nerode Theorem. 7

b) Convert the grammar {S→AaCb / ABa, A→bAa / a, B→BaB / b, C→c} to CNF

16 a) Convert the Context-Free Grammar with productions: 7

{S→ aSb|ε} into Greibach Normal form.

b) Convert the Context-Free Grammar with productions: 7

{S → aSa|bSb|SS|ε}into Chomsky Normal form.

Module -4

17 a) Design a PDA for the language L= { WW^r| W ∈{a,b}* }. Also illustrate the computation of the PDA on the string 'aabbaa'. 7

b) State Equivalence theorem between empty stack PDA and Final State PDA. 7

18 a) Design a PDA for strings in which number of a's is less than number of b's. 7

b) Using Pumping lemma prove the given language is not context free. 7
$L=\{a^n b^{2n} c^n | \text{where } n>=1\}$.

Module -5

19 a) Define formally Type 0, Type 1, Type 2 and Type 3 grammar. Show the corresponding automata for each class 7

b) Design a TM to find the sum of two numbers m and n. Assume that initially the tape contains m number of 0s followed by # followed by n number of 0s 7

20 a) Design a Liner Bounded Automata for the language $L=a^n b^n c^n \mid n>=1\}$ 7

b) Prove that 'Turing Machine halting problem' is undecidable. 7

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