

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'. $\Sigma = \{0,1\}$. | 3 |
| 2 | Design a DFA for strings in which first and last letters do not match. $\Sigma = \{a, b\}$. | 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**

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|----|--|---|
| 11 | a) Construct an ϵ -NFA for the language $L = \{0^n 1^m 2^p \mid n, m, p \geq 0\}$ 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. $\Sigma = \{a, b\}$. | 6 |
| 12 | a) Draw the state-transition diagram showing an NFA N for the following language | 7 |

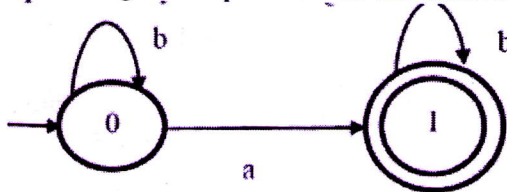
L. Obtain the DFA D equivalent to N by applying the subset construction algorithm.

$L = \{x \in \{a, b\}^* \mid x \text{ contains 'bab' as a substring}\}$.

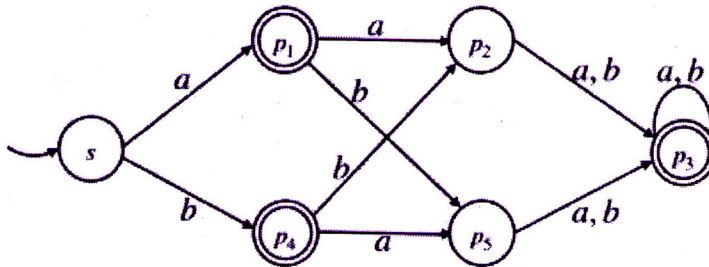
- b) Construct a regular grammar for $L = \{0^n 11 \mid n \geq 1\}$. Construct deterministic finite automata for the same. 7

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 $L = \{0^n \mid n \text{ is perfect square}\}$ is not regular. 7

Module -3

- 15 a) State Myhill- Nerode Theorem. Prove the language $L = \{a^n b^n, \text{ where } n \geq 1\}$ is not Regular using Myhill-Nerode Theorem. 7
 b) Convert the grammar $\{S \rightarrow AaCb \mid ABa, A \rightarrow bAa \mid a, B \rightarrow BaB \mid b, C \rightarrow c\}$ to CNF 7
- 16 a) Convert the Context-Free Grammar with productions: $\{S \rightarrow aSb \mid \epsilon\}$ into Greibach Normal form. 7
 b) Convert the Context-Free Grammar with productions: $\{S \rightarrow aSa \mid bSb \mid SS \mid \epsilon\}$ into Chomsky Normal form. 7

Module -4

- 17 a) Design a PDA for the language $L = \{WW^R \mid W \in \{a,b\}^*\}$. 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
 $L = \{a^n b^{2n} c^n \mid n \geq 1\}$.

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 $L = \{a^n b^n c^n \mid n \geq 1\}$ 7
b) Prove that 'Turing Machine halting problem' is undecidable. 7
