Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

B.Tech Degree S5 (R,S) (FT/WP/PT) Examination November 2025 (2019 Scheme)

Course Code: CST301

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	Design a DFA for set of strings of a's and b's with substring aba.	3
2	Construct a regular grammar for L= $\{0^n 1 \mid n \geq 1\}$	3
3	Draw an ε-NFA for (a* + b*)*	3
4	Write regular expression for all strings of 0's and 1's not having 2 consecutive 0's.	3
5	Find the equivalence classes of Canonical Myhill-Nerode relation for set of all strings of a's and b's ending with a.	3
6	Show that the grammar E → **E - E | a | b** isambiguous.	3
7	Using pumping lemma, prove that L = { ww | w ε (0+1)* is not a CFL	3
8	Design a PDA to accept equal number of a's and b's.	3
9	Design a Turing machine to double a binary integer.	3
10	Design a Context Sensitive Grammar for the language L = $\{a^n b^n c^n \mid n \geq 0\}$	3

PART B

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

Module -1

11	a)	Design a DFA for set of strings of 0's and 1's with odd number of 0's and 1's. Also write a regular grammar for the DFA.	6
	b)	Design a NFA for A = {x ∈ $(a+b)^*$ | second symbol from right is 1}. Convert this	8

NFA to DFA.

12 a) Design a DFA that accepts binary strings starting with 1 and divisible by 5. 6

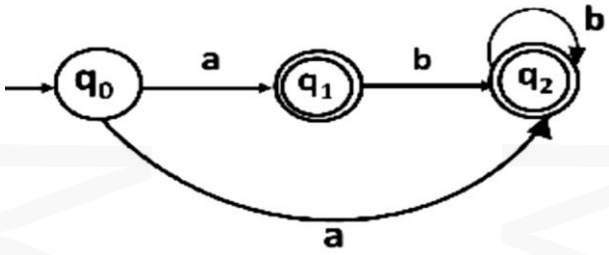
b) Convert ε-NFA to NFA. The transition table is given below. 8

States	ε	a	b
→qo	{q2}	{q1}	{q0}
q1	{q2}	q2}	{q3}
*q2	{q0}	ϕ	ϕ
q3	ϕ	ϕ	{q2}

Module -2

13 a) Construct an ε-NFA for (ab + b)*a* + ab 7

b) Construct the regular expression for the Finite Automata 7



14 a) Prove that L={a ^{n} | n is a perfect square} not regular. 7

b) Minimize the DFA using table filling method. The transition table is shown below. 7

States	0	1
->q0	q1	q3
q1	q2	q4
q2	q1	q4
q3	q2	q4
* q4	q4	q4

Module -3

15 a) Remove the useless symbols of the CFG given by 5

S→AB |CA B→ BC | AB A→a C → aB | b

b) Convert to Greibach Normal Form(GNF) 9

$S \rightarrow XA \mid BB \quad B \rightarrow b \mid SB \quad X \rightarrow b \quad A \rightarrow a$

16 a) Convert to Chomsky Normal Form 8

$S \rightarrow aAb \qquad A \rightarrow aB \mid bB \mid \varepsilon \qquad B \rightarrow A \mid c$

b) Derive the string "aabbabba" using leftmost, rightmost derivation and parse tree for $S \rightarrow aB \mid bA \quad A \rightarrow a \mid aS \mid bAA \quad B \rightarrow b \mid bS \mid aBB$ 6

Module -4

17 a) Design a NPDA to recognize set of all palindromes over {0,1} 8

b) Prove that CFLs are closed under Union, Concatenation and Kleene Closure. 6

18 a) Design a DPDA for $L=\{a^i b^j c^{i+j} \mid i, j \geq 1\}$. Illustrate the computation of PDA on the string aaabbccccc. 8

b) Convert the grammar S -> 0AA, A -> 0S | 1S | 0 to a PDA that accepts the same language by empty stack. 6

Module -5

19 a) Compare recursive and recursively enumerable languages. 6

b) Design a Turing machine to subtract two unary numbers. Illustrate the computation of TM on the input 3 - 2. 8

20 a) Prove that TM halting problem is undecidable. 7

b) Explain Chomsky hierarchy for formal languages. 7

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