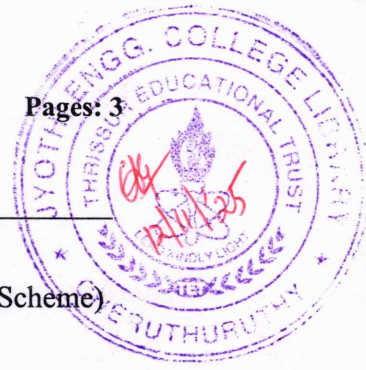


Reg No.: _____

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 $E \rightarrow E - E \mid a \mid b$ is ambiguous. | 3 |
| 7 | Using pumping lemma, prove that $L = \{ww \mid w \in (0+1)^*\}$ 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 $A = \{x \in (a+b)^* \mid \text{second symbol from right is } 1\}$. Convert this 8

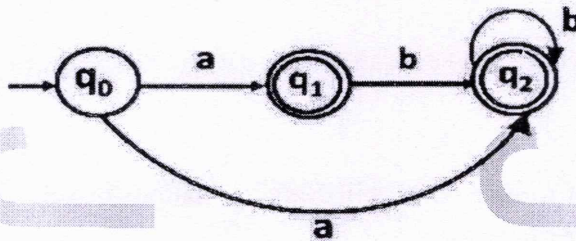
NFA to DFA.

- 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
$\rightarrow q_0$	$\{q_2\}$	$\{q_1\}$	$\{q_0\}$
q_1	$\{q_2\}$	q_2	$\{q_3\}$
$*q_2$	$\{q_0\}$	ϕ	ϕ
q_3	ϕ	ϕ	$\{q_2\}$

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 $L = \{a^n \mid n \text{ is a perfect square}\}$ not regular. 7
- b) Minimize the DFA using table filling method. The transition table is shown below. 7

States	0	1
$\rightarrow q_0$	q_1	q_3
q_1	q_2	q_4
q_2	q_1	q_4
q_3	q_2	q_4
$*q_4$	q_4	q_4

Module -3

- 15 a) Remove the useless symbols of the CFG given by 5
- $S \rightarrow AB \mid CA \quad B \rightarrow BC \mid AB \quad A \rightarrow a \quad C \rightarrow aB \mid b$
- 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

$S \rightarrow aAb \quad A \rightarrow aB \mid bB \mid \epsilon \quad B \rightarrow A \mid c$

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

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 $S \rightarrow 0AA, A \rightarrow 0S \mid 1S \mid 0$ 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
