Reg No.:_____ Name:_____

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APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

B.Tech Degree S5 (S,FE) (FT) (WP/PT) Examination May 2025 (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	Design a DFA for the language for the set of strings over {a,b}* whose length is divisible by 3.	3
2	Write the applications of Finite Automata.	3
3	Write any three closure properties of regular languages.	3
4	Write a regular expression for the set of strings whose 5^{th} symbol from the end is b for $\sum$={a,b}.	3
5	State Myhill Nerode theorem? List the applications of Myhill Nerode Theorem.	3
6	Construct a CFG to generate a set of strings with equal number of a's and b's.	3
7	Define Deterministic Pushdown Automata.	3
8	Prove that $L=\{a^nb^nc^n \mid n>=1\}$ is not context free using pumping lemma of CFL.	3
9	Write and explain the instantaneous description of a Turing machine.	3
10	Define Chomsky Classification of Formal languages.	3

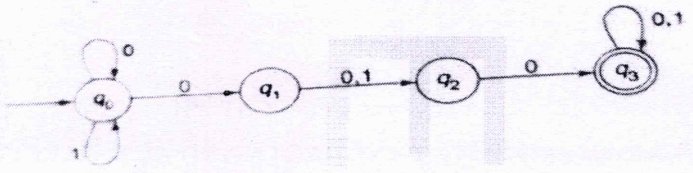
PART B

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

Module -1

11	a)	Prove that "Let L be a set accepted by a Nondeterministic Finite Automaton. Then there exists a deterministic Finite Automaton that accepts L".	7

b) For the following NFA find equivalent DFA and draw the transition diagram of equivalent DFA. 7



12 a) Let G={V,T,P,S} be a regular grammar where V={S,A,B}, T={0,1,+,-}, S=S 7

Production rules P:

S->0A | 1A

A->0A | 1A | +B | -B

B->0B | 1B | 0 | 1

Construct a Finite Automata that accepts the language generated by a given grammar G.

b) Write a grammar which generate strings containing even number of 'a' and even number of 'b' over ∑={a,b}. 7

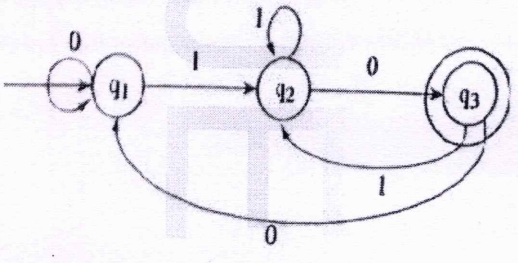
Module -2

13 a) Construct a NFA accepting the language denoted by the following regular expression (using Thompson's Construction method). 4

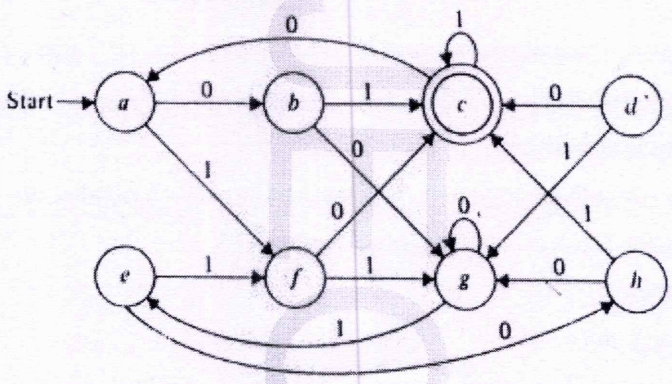
b(a+b)*aa

b) i) Define ultimate periodicity. Using Ultimate periodicity check whether the language $L = \{ a^{n!} \mid n>=0\}$ is regular or not. 3+7

ii) Construct a regular expression equivalent to the Finite Automata given below:



14 a) Let M be the finite automaton as shown in the figure. Minimize the automata. 8



b) i) What are the conditions needed for pumping lemma for regular sets? 2+4

ii) Prove that $L=\{ww^R | w$ is the element of$\{0,1\}^*$ and w^R is the reverse of $w\}$ is not regular using pumping Lemma.

Module -3

15 a) Consider the grammar 6

S->aB | bA

A->a | aS | bAA

B->b | bS | aBB

For the string 'aaabbabbba' give:

i) leftmost derivation

ii) rightmost derivation

iii) derivation tree

iv) Is the grammar ambiguous? Justify your answer.

b) Convert the grammar below to CNF: 8

S->ASB | ε

B->SbS | A | bb

A->aAS | a

16 a) Convert the following grammar to Greibach Normal Form: 8

A_1->A_2A_3

A_2->A_3A_1 | b

A_3->A_1A_2 | a

b) Remove the Useless symbols from the grammar below: 6

S->aB | aCD | aE

B->bC

C->aB | b

D->aE

E->bCD

Module -4

17	a)	Construct Push down Automata to recognize $L=\{a^n b^n c^m \mid n,m >= 1\}$.	6
	b)	Explain two modes of language acceptability of a PDA and define instantaneous description of PDA.	8
18	a)	Construct a PDA equivalent to the grammar. Check whether the grammar can generate the string 'abaaaa' which is accepted by PDA. S-> aAA A-> aS | bS | a	7
	b)	i) List two CFLs which cannot be accepted by DPDA? Justify. ii) Design PDA which to recognize all palindromes over{0,1}.	7

Module -5

19	a)	Construct a Turing Machine for the language $\{L=0^n 1^n 2^n \mid n>=1\}$.	7
	b)	i) Differentiate Nondeterministic Turing machine and Deterministic Turing Machine. ii) Define Multitape turing Machine.	4+3
20	a)	Explain Universal Turing Machine.	6
	b)	i) Write short note on Recursive and Recursive enumerable Languages. ii) Design a Turing Machine to add two unary integers.	3+5

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