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APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

B.Tech Degree S5 (S,FE) (FT/WP/PT) Examinations May/June 2026 (2019 Scheme)

Course Code: CST301
Course Name: FORMAL LANGUAGES AND AUTOMATA THEORY

Max. Marks: 100 Duration: 3 Hours

PART A

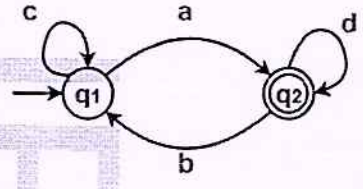
(Answer all questions; each question carries 3 marks) Marks

1 Explain the difference you notice in the transition functions of DFA, NFA and ε-NFA. 3

2 Draw a DFA for the language accepting strings ending with 'abb' over input alphabet $\sum$={a,b}. 3

3 Explain any 3 closure properties of regular languages. 3

4 Write the regular expression corresponding to the DFA given below 3



5 Define the following terms 3

(i) Sentential form

(ii) Left most derivation

(iii) Unit Production.

6 Draw a parse tree for the string "aabbabba " for the CFG given by 3

$S \rightarrow aB \mid bA$

$A \rightarrow a \mid aS \mid bAA$

$B \rightarrow b \mid bS \mid aBB$

7 Write the pumping lemma for CFLs. How to use the pumping lemma to show a language L is **not** context-free. 3

8 Design PDA for balanced parentheses. 3

9 Differentiate between recursive and recursively enumerable languages. 3

10 Compare multi-tape and multi-track Turing machine. 3

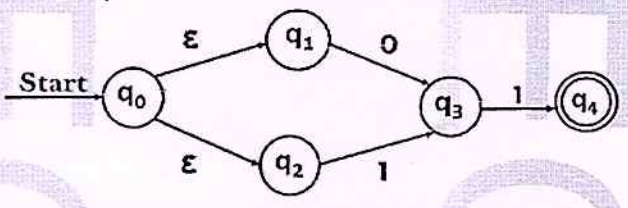
PART B

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

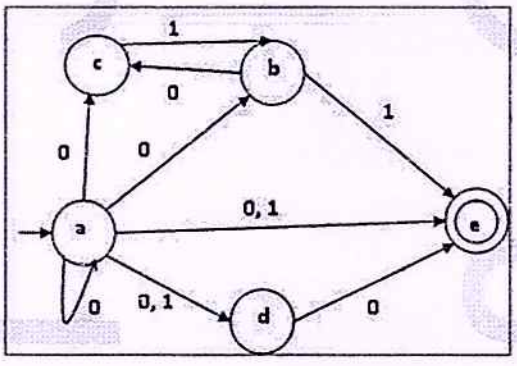
Module -1

11 a) Draw a DFA that accepts binary numbers divisible by 5. Write the transition table also. 7

b) Convert the following ε-NFA to DFA. 7



12 a) Convert the following NFA to equivalent DFA. 7



b) Prove the statement "Every language that can be described by some NFA can also be described by Some DFA" 7

Module -2

13 a) Write the regular expressions for 8

(a) The language that accepts even number of 0's over $\sum = \{0,1\}$

(b) The language that accepts strings of even length and begins with 01 over $\sum = \{0,1\}$

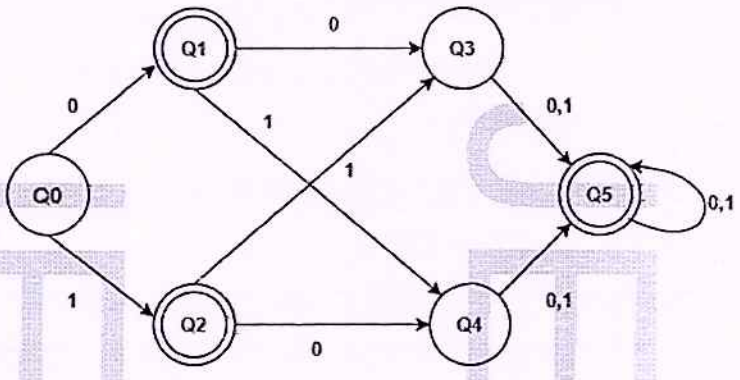
(c) The language consists of the string in which a's appear triples, there is no restriction on the number of b's over $\sum = \{a, b\}$

(d) The language that accepts with 011 as substring over $\sum = \{0,1\}$

b) Using pumping lemma show that $L = \{ yy \mid y \in \{0,1\}^* \}$ is not regular 6

14 a) Construct an ε-NFA corresponding to the regular expression (0+1)*(00+11)(0+11)* 6

b) Minimize the following DFA using table filling method. 8



Module -3

15 a) Write the CFG for the following languages 6

(a) Construct a CFG that accepts all strings from the language

$L = \{w \mid w = w^R$ and $\Sigma = \{a, b\}\}$

(b) Construct a CFG for the regular expression (a+b)*aa(a+b)*

(c) Construct a CFG that accepts all strings of different first and last symbols over $\sum$ =(a,b)

b) What is the relation between Myhill Nerode equivalence classes and states of DFA? Explain how the Myhill Nerode relation can be used to minimise a DFA. 8

16 a) 6

Check whether the given grammar is ambiguous or not for the string

w = aabbccdd

$S \rightarrow AB \mid C$, $A \rightarrow aAb \mid ab$, $B \rightarrow cBd \mid cd$, $C \rightarrow aCd \mid aDd$, $D \rightarrow bDc \mid bc$

b) Convert the following grammar to Greibach Normal form. 8

$S \rightarrow AB$

$A \rightarrow BS \mid b$

$B \rightarrow SA \mid a$

Module -4

17 a) Design PDA for the language $L=WW^R$. Illustrate the working with suitable example 8

b) Construct a CFG from the following PDA transitions 6

$\delta(q_0, a, z_0) \rightarrow (q_0, az_0)$

$\delta(q_0, a, a) \rightarrow (q_0, aa)$

$\delta(q_0, b, a) \rightarrow (q_1, \varepsilon)$

$\delta(q_1, b, a) \rightarrow (q_1, \varepsilon)$

$\delta (q_1, \varepsilon, z_0) \rightarrow (q_2, \varepsilon)$

18	a)	Using Pumping lemma prove the given language is not context free $L=\{ a^n b^{2n} c^n , n>0 \}$	6
	b)	Design a push down automata for $L= \{ a^i b^j c^k \mid i=j$ or $j=k$ and i, j and $k>1\}$	8

Module -5

19	a)	Prove that 'Turing Machine halting problem is undecidable'.	7
	b)	Design a TM for $L = \{a^n b^n c^n \mid n > 0\}$. Illustrate the working with suitable example	7
20	a)	Explain Chomsky hierarchy for formal languages with suitable diagrams	7
	b)	Design an LBA for $L = \{a^{2n} b^n \mid n > 0\}$. Illustrate the working with suitable example	7

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