Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

B.Tech Degree S5 (S, FE) / S5 (PT) (S) Examination June 2024 (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 (with or without ϵ-moves) for strings starting with '10' or '11'. $\sum = \{0,1\}$	3
2	Define the language acceptability by DFA, NFA and Ɛ-NFA	3
3	Write down the regular expression for strings with even number of a's. $\sum = \{a, b\}$	3
4	How can we identify two equivalent states in a DFA?	3
5	Is the grammar ***'E → E+E / E*E / a'*** ambiguous? Justify your answer.	3
6	State Myhill - Nerode Theorem	3
7	Differentiate between DPDA and NPDA	3
8	List out the transition rules **'δ'** used to convert given CFG ***G*** to its equivalent NPDA ***M.***	3
9	Explain how Turing Machine differs from PDA.	3
10	Why TM model is widely accepted and considered as a general model for computers?	3

PART B

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

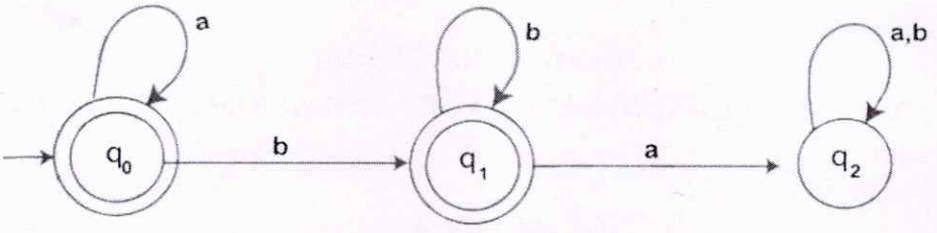
Module -1

11	a)	Prove that for every NFA M, there exist an equivalent DFA M'	7
	b)	Design an NFA (without Ɛ-moves) for strings ending with '01'. Convert it into equivalent DFA. $\sum = \{0, 1\}$	7
12	a)	Draw the transition diagram of DFA for $L = \{ baxb / x \in \{a, b\}^* \}$ and obtain its regular grammar	7

b) Prove that, if L is accepted by an ordinary NFA, there exist an equivalent ϵ-NFA that also accepts L 7

Module -2

13 a) Obtain the regular expression equivalent to the following DFA



7

b) Develop equivalent automata for the Regular Expression $(ab+b)^*(a+bb)^*a^*$ 7

14 a) Prove that for every Regular Expression ***'R'***, there is an ϵ-NFA ***'M'*** 7

b) Using pumping lemma, show that $L=\{ a^p / p$ **is a prime number** $\}$ is not regular 7

Module -3

15 a) What is Greibach Normal Form (GNF)? Convert the following CFG to GNF 7

S → ABA, A → aA / Ɛ, B → bB / Ɛ

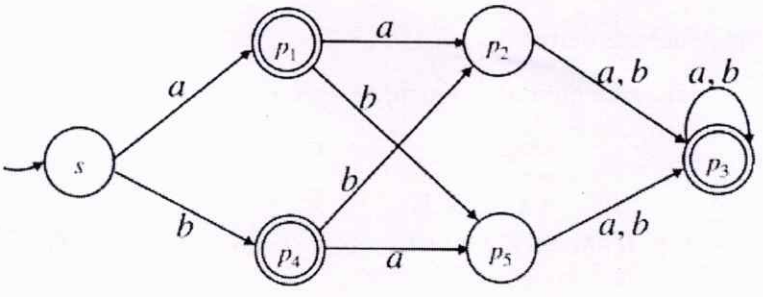
b) a) Design CFG for the following languages

(i) $L=\{ wcw^R / w \in \{a, b\}^* \}$ where w^R represents reverse of w

(ii) Stings with exactly 2 zeros. $\sum = \{0, 1\}$ 7

(iii) $(011+1)^*(01)^*$

16 a) Minimize the following DFA using Myhill – Nerode theorem



7

b) Show the equivalence classes of Canonical Myhill – Nerode relation for the languages of binary strings with odd number of zeros and even number of ones. 7

Module -4

17 a) Prove that for every PDA accepted by empty stack, there exists an equivalent PDA accepted by final state. 7

b) Design PDA for $L = \{ a^i b^j c^k / k = i + j \}$. Illustrate the working for the string **'aabbcccc'** 7

18 a) Design PDA for $L = \{ ww^R / w \in \{a, b\}^* \}$. 7

b) State and prove any three closure properties of Context Free Languages. 7

Module -5

19 a) Design TM for $L = \{ a^n b^n / n > 0 \}$. Trace out the working for the input string **'aabb'** 7

b) Explain Chomsky hierarchy for formal languages and evaluate various types 7

20 a) Design a TM to copy a block of zeros to the right side, leaving one blank symbol (b) in between. Assume that initially the input tape contains $\mathbf{b0^nb}$ and TM halts with $\mathbf{b0^nb0^nb}$ as the tape content. 7

b) Explain the working of Universal Turing Machine with its encoding scheme 7

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