1100CST301122202
DRAFT SCHEME

Total Pages: 4

Scheme of Valuation/Answer Key

(Scheme of evaluation (marks in brackets) and answers of problems/key)

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
FIFTH SEMESTER B.TECH DEGREE(R/S) EXAMINATIONS, DECEMBER **2022**
(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		Ɛ-closure definition – 1 ½ marks Example – 1 ½ marks	3
2		Correct DFA – 3 marks Transition diagram or table or functions may be accepted	3
3		Regular expression – 3 marks *Sample answer: (b* a b* a b* a)* b** Any correct expression may be given with full marks	3
4		Any 3 closure properties of regular languages – 1 mark each	3
5		Ambiguous grammar: Explanation - 1 ½ marks Example – 1 ½ marks	3
6		Myhill - Nerode Theorem – Statement 3 marks A language is regular if and only if $\equiv_L$ partitions $\sum^*$ into finitely many equivalence classes. If $\equiv_L$ partitions $\sum^*$ into **n** equivalence classes, then a minimal DFA recognizing L has exactly **n** states. *Note: Full marks may be awarded for Myhill – Nerode Relation statements also*	3
7		DPDA and NPDA are not equivalent – 1 mark Explanation with example – 2 marks (May state a sample problem like 'ww' for which no DPDA exist , but NPDA exist)	3
8		CNF production format – 1 mark Conversion steps to Chomsky Normal Form – 2 marks	3
9		Formal definition of Turing Machine – 3 marks	3

10		Explanation on Recursive languages – 1 ½ marks Recursively Enumerable languages - 1 ½ marks	3
PART B			
(Answer one complete question from each module)			
Module -1			
11	a)	Prove that, if L is accepted by an ordinary NFA, there exist an equivalent ϵ-NFA that also accepts L *Proof using mathematical induction* *Base case – 1 ½ marks* *Induction hypothesis – 1 ½ marks* *Induction step – 4 marks*	7
	b)	*Correct NFA – 3 marks* *Conversion steps to DFA – 3 marks* *Final DFA – 1 mark*	7
12	a)	*Correct Ɛ-NFA – 3 marks* *Conversion steps to ordinary NFA – 3 marks* *Final NFA – 1 mark*	7
	b)	*Correct NFA – 3 marks* *Conversion steps to DFA – 3 marks* *Final DFA – 1 mark*	7
Module -2			
13	a)	Using pumping lemma, show that $L = \{ a^n b^n / n > 0 \}$ is not regular *Stating pumping lemma conditions – 2 marks* *Selecting suitable string – 2 marks* *Proving – 3 marks*	7
	b)	Steps – 4 marks Final diagram – 3 marks *Note: Any method like Kleene's theorem may be used. Steps are mandatory*	7
14	a)	Prove that for every Regular Expression ***'R',*** there is an ϵ-NFA ***'M'*** *Proof using mathematical induction* *Base case – 1 ½ marks*	7

		Induction hypothesis – 1 ½ marks *Induction step – 4 marks*	
	b)	*Rules for writing regular expressions – 2 marks* (Eg Rule; Union of 2 RE is R1+R2) Solutions using any method like Kleene's construction or Arden's theorem etc. may be positively considered *Steps - 3 marks* *Final answer – 2 marks*	7
Module -3			
15	a)	Greibach Normal Form (GNF) *GNF format – 2 marks* *Renaming variables – 1 mark* *Eliminating left recursion – 2 marks* *Proper substitutions – 2 marks*	7
	b)	a) Any correct answer may be awarded with full marks. Sample productions as follows: (i) $S \rightarrow aSa / bSb / a / b / \varepsilon$ - *2 marks* (ii) $S \rightarrow A0A0A0,\ A \rightarrow 0A / 1A / \varepsilon$ - *2 marks* (iii) $S \rightarrow ABA,\ A \rightarrow 0A / 1A / \varepsilon,\ B \rightarrow 01B / \varepsilon$ - *3 marks*	7
16	a)	DFA minimization using Myhill – Nerode theorem *Initial table – 1 mark* *Steps for filling the table – 3 marks* *Final table – 1 mark* *Final DFA – 2 marks* Note: Fractional marks may be given for minimization using other methods like quotient construction method	7
	b)	Chomsky Normal Form (CNF) *CNF format – 2 marks* *Eliminating ε-productions and unit productions – 2 marks* *Proper substitutions – 3 marks*	7
Module -4			

17	a)	Prove that for every PDA accepted by final state, there exists an equivalent PDA accepted by empty stack. *Explanation/diagram – 4 marks* *Rules , δ – 3 marks*	7
	b)	PDA rules *δ* or diagram – 4 marks Instantaneous Description (ID) with an eg – 3 marks	7
18	a)	PDA rules *δ* or diagram – 7 marks	7
	b)	*Stating pumping lemma conditions – 2 marks* *Selecting suitable string – 2 marks* *Proving – 3 marks*	7
Module -5			
19	a)	TM diagram or rules δ – 4 marks Instantaneous Description (ID) – 3 marks	7
	b)	Chomsky hierarchy for formal languages Type 0, 1, 2 & 3 Each type – 1 ½ marks *(Name of language – ½ marks* *Format of production - ½ marks* *Corresponding Machine - ½ marks)* Final comparison/evaluation – 1 mark	7
20	a)	TM diagram or rules δ – 7 marks	7
	b)	Statement/diagram – 2 marks Proof/explanation – 5 marks	7
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There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which a student should answer any one. Each question can have maximum 2 sub-divisions and carries 14 marks.