Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

Fifth Semester B.Tech Degree Regular and Supplementary Examination December 2020

Course Code: CS301

Course Name: THEORY OF COMPUTATION

Max. Marks: 100 Duration: 3 Hours

PART A

Answer all questions, each carries 3 marks. Marks

1		Design a DFA to accept the set of binary strings ending with 0	(3)
2		Show the formal definition of the transition relation in an ε-NFA. Illustrate how a transition is performed by an ε-NFA.	(3)
3		List two differences between Moore and Mealy Machines. Give a Mealy machine with the minimum possible number of states that outputs the one's complement of a given binary string.	(3)
4		Give a regular grammar for the language {$w \in \{a, b\}^* \mid w$ has even number of 'a's and even number of 'b's}	(3)

PART B

Answer any two full questions, each carries 9 marks.

5	a)	Design a DFA for the language {$w \in \{0, 1\}^* \mid w$, when considered as an integer, is a multiple of 3}.	(6)
	b)	Design a DFA for the language {$w \in \{a, b\}^* \mid w$ did not contain 'aab' as a substring}.	(3)
6	a)	Find an ε-NFA for the language L($a(a+b)^*b$) employing the rules for regular expression to ε-NFA conversion.	(3)
	b)	Convert the above ε-NFA into an equivalent DFA, clearly showing the steps of the standard procedure for the same.	(6)
7		Find a DFA and a regular expression for the language {$w \in \{a, b\}^* \mid w$ has odd number of 'a's}.	(9)

PART C

Answer all questions, each carries 3 marks.

8		When a Grammar is said to be ambiguous? Show that the grammar with productions P = {E → E + E | E * E | (E) | a } for simple arithmetic expressions, is ambiguous.	(3)

9		Given that, the language $\{a^n b^n \mid n \geq 0\}$ is not regular. Prove that the language $\{w \in \{a, b\}^* \mid w$ has equal number of 'a's and 'b's$\}$ is not regular, without using Pumping Lemma.	(3)
10		Give a formal definition for NPDA.	(3)
11		Give a PDA which accepts the language $\{a^n b^n \mid n > 0\}$ by empty stack	(3)

PART D

Answer any two full questions, each carries 9 marks.

12		Is the following language regular? Prove it.	(9)
	(i)	$\{w \in \{0, 1\}^* \mid$ the length of w is a prime number$\}$	
	(ii)	L* (i.e., the Kleene closure of L) where L = $\{a^p \mid$ where p is a prime number$\}$	
13		Give a CFG with two productions for the language $\{a^{4n} \mid n > 0\}$and convert it into Chomsky Normal Form.	(9)
14		Prove that there is a PDA which accepts a language L by final state *if and only if* there is a PDA which accepts L by empty stack.	(9)

PART E

Answer any four full questions, each carries 10 marks.

15	a)	State 'Pumping Lemma for Context Free Languages.'	(3)
	b)	Prove that the language $\{0^n 1^n 2^n \mid n > 0\}$ is not a CFL.	(7)
16	a)	Design a Turing Machine which accepts the set of all palindromes over $\{a, b\}$	(8)
	b)	Show the computations done by the above machine when the input is '1001' by means of Instantaneous Descriptions (IDs).	(2)
17		Design a Turing Machine that multiplies two unary numbers, by first giving an outline of the strategy of operation of the machine in English sentences.	(10)
18	a)	Give the structure and explain the working of a Multi-tape Turing Machine	(5)
	b)	Give a formal definition for a Non-deterministic Turing Machine. Show an example NDTM	(5)
19	a)	Prove that if a language L is recursive, so is its complement.	(5)
	b)	Prove that if both a language L and its complement are recursively enumerable, then L is recursive.	(5)
20		Prove that 'Turing Machine Halting Problem' is undecidable.	(10)

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