

Reg No.: \_\_\_\_\_

Name: \_\_\_\_\_

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY**  
FIFTH SEMESTER B.TECH DEGREE EXAMINATION, APRIL 2018

**Course Code: CS301**

**Course Name: THEORY OF COMPUTATION (CS)**

Max. Marks: 100

Duration: 3 Hours

**PART A**

*Answer all questions, each carries 3 marks*

Marks

- |   |   |     |
|---|---|-----|
| 1 | Construct regular expression for the language that consists of all strings ending with 00. Assume $\Sigma = \{0, 1\}$ .   | (3) |
| 2 | Design non deterministic automata (without $\epsilon$ moves) for the regular language that consist of all strings with at least two consecutive 0's. Assume $\Sigma = \{0, 1\}$ . | (3) |
| 3 | Define regular grammar with suitable example.   | (3) |
| 4 | List some of the applications of automata theory.   | (3) |

**PART B**

*Answer any two full questions, each carries 9 marks*

- |   |  |     |
|---|--|-----|
| 5 | Prove the equivalence of non deterministic finite automata and deterministic finite automata.              | (9) |
| 6 | Prove the equivalence of non deterministic finite automata with $\epsilon$ moves and regular expressions.  | (9) |
| 7 | a) Construct non deterministic finite automata (with $\epsilon$ moves) for regular expression $(0+1)^*1$ . | (4) |
|   | b) Compare and contrast Moore and Mealy machines. (Justify with diagrams).                                 | (5) |

**PART C**

*Answer all questions, each carries 3 marks*

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|----|--|-----|
| 8  | Construct context free grammar for $L = \{wcw^R \mid w \text{ in } (a+b)^*\}$ , Reverse of $w$ is denoted as $w^R$ . | (3) |
| 9  | List conditions for symbols to become <i>useful</i> symbols in context free grammar.                                 | (3) |
| 10 | List conditions required for push down automata to qualify as deterministic push down automata.                      | (3) |
| 11 | List closure properties of context free language.  | (3) |

**PART D**

*Answer any two full questions, each carries 9 marks*

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|----|---|-----|
| 12 | Do the following:   | (9) |
|    | i) Construct push down automata with empty stack as final condition for Context free language, $L = \{wcw^R \mid w \text{ in } (a+b)^*\}$ . Reverse of $w$ is denoted as $w^R$ .  |     |
|    | ii) Describe all instantaneous descriptions from initial ID (start state, <b>abcba</b> , initial stack symbol) $\vdash^*$ to final ID (state, $\epsilon$ , $\epsilon$ ) with respect to constructed push down automata. |     |

- 13 Do the following: (9)
- i) Derive any two representative strings with minimum length 4 from following context free grammar.  $G = (\{S, A, B\}, \{a, b\}, P, S)$   
 $S \rightarrow bA \mid aB$   
 $A \rightarrow bAA \mid aS \mid a$   
 $B \rightarrow aBB \mid bS \mid b$
- ii) Draw derivation tree corresponding to string **aabbab** with respect to aforementioned grammar.
- 14 Prove the equivalence of push down automata and context free grammar. (9)

**PART E**

*Answer any four full questions, each carries 10 marks*

- 15 a) State pumping Lemma for context free language (5)  
 b) Define formally Turing machine Model. (5)
- 16 a) Design Turing machine to accept language  $L = \{0^n 1^n \mid n \geq 1\}$  (6)  
 b) Describe all instantaneous descriptions (ID) from initial ID  $q_0 01$  to Final ID with respect to constructed TM. Assume  $q_0$  as start state. (4)
- 17 a) Design Turing machine to compute addition of two numbers. Assume unary notation for number representation. (6)  
 b) Describe all instantaneous descriptions (ID) from initial ID:  $q_0 010$  to Final ID:  $00$  with respect to constructed Turing Machine. (assume  $q_0$  as initial state.) (4)
- 18 a) Explain the significance of universal Turing machine. (5)  
 b) Compare and contrast recursive and recursively enumerable languages. (5)
- 19 a) Prove that union of two recursive languages is recursive. (5)  
 b) Explain the significance of halting problem. (5)
- 20 a) Explain general notations for productions of each formal language from Chomsky hierarchy. (5)  
 b) Prove that complement of a recursive language is recursive. (5)

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