

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

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|---|---|-----|
| 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 ϵ 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

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|---|--|-----|
| 5 | Prove the equivalence of non deterministic finite automata and deterministic finite automata. | (9) |
| 6 | Prove the equivalence of non deterministic finite automata with ϵ moves and regular expressions. | (9) |
| 7 | a) Construct non deterministic finite automata (with ϵ 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, abcba , initial stack symbol) \vdash^* to final ID (state, ϵ , ϵ) 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)
