

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

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

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY**  
**FIFTH SEMESTER B.TECH DEGREE EXAMINATION(R&S), DECEMBER 2019**

**Course Code: CS301**

**Course Name: THEORY OF COMPUTATION**

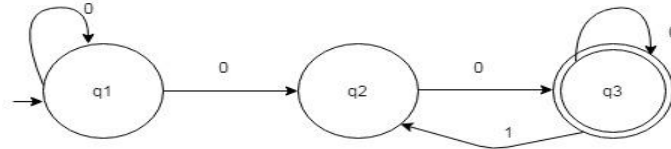
Max. Marks: 100

Duration: 3 Hours

**PART A**

*Answer all questions, each carries 3 marks.*

- |   |  | Marks |
|---|--|-------|
| 1 | Define nondeterministic finite automata(NFA). Draw the NFA for the language $L=\{a^n b^m \mid n, m \geq 1\}$ | 3     |
| 2 | Convert the following NFA to DFA.  | 3     |



- |   |   |   |
|---|---|---|
| 3 | Write regular expression for the language $L=\{1^n 0^m \mid n \geq 1, m \geq 0\}$                 | 3 |
| 4 | Differentiate Moore machine from Mealy machine. Write the tuple representation for both machines. | 3 |

**PART B**

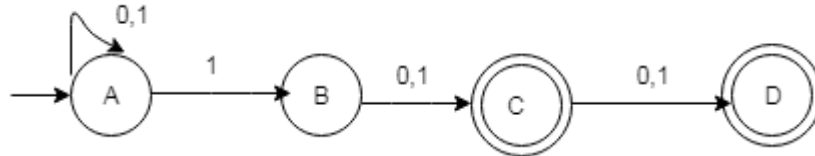
*Answer any two full questions, each carries 9 marks.*

- |   |   |   |
|---|---|---|
| 5 | a) Write the notation for the language defined by a DFA. Write a string belong to the language $L^3$ if $L=\{0,1\}$ .   | 3 |
|   | b) Construct NFA without $\epsilon$ – transitions from the following NFA. $M=(\{q_0, q_1, q_2\}, \{a, b, c\}, \delta, q_0, \{q_2\})$ and $\delta(q_0, a) = \{q_0\}$ , $\delta(q_0, b) = \{q_1\}$ , $\delta(q_0, c) = \{q_2\}$ , $\delta(q_1, \epsilon) = \{q_0\}$ , $\delta(q_1, a) = \{q_1\}$ , $\delta(q_1, b) = \{q_2\}$ , $\delta(q_2, \epsilon) = \{q_1\}$ , $\delta(q_2, a) = \{q_2\}$ , $\delta(q_2, c) = \{q_0\}$ . | 6 |
| 6 | a) State Myhill-Nerode Theorem.   | 3 |
|   | b) Minimize the following DFA.  | 6 |

| $\delta$   | a  | b  |
|------------|----|----|
| <b>P0</b>  | P0 | P1 |
| <b>P1</b>  | P2 | P1 |
| <b>P2</b>  | P3 | P1 |
| <b>*P3</b> | P3 | P4 |
| <b>*P4</b> | P5 | P4 |

|     |    |    |
|-----|----|----|
| *P5 | P3 | P4 |
|-----|----|----|

- 7 a) Construct regular expression corresponding to the following state diagram: 4.5



- b) Design an  $\epsilon$ -NFA for the regular expression  $(0+1)^*01$  4.5

### PART C

*Answer all questions, each carries 3 marks.*

- 8 Write the conditions for a pushdown automaton to be considered as deterministic. 3
- 9 Which are the methods to accept a string in a PDA? Whether both type of PDAs can define the same language. Justify your answer. 3
- 10 Convert the following grammar to Chomsky Normal Form. 3  
 $S \rightarrow 0S0 \mid 1S1 \mid \epsilon$
- 11 Whether the following grammar is ambiguous? 3  
 $E \rightarrow E+E \mid E^*E \mid I$   
 $I \rightarrow 0 \mid 1 \mid a \mid b$

### PART D

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

- 12 a) Verify that the following languages is not regular: 4.5  
 $\{a^n b^{2n} \mid n > 0\}$
- b) Which of the following operations are closed under regular sets. Justify your answer. 4.5  
 i) Complementation ii) Set difference iii) string reversal iv) Intersection
- 13 a) Give a CFG for the language  $N(M)$  where  $M = (\{p, q, r\}, \{0, 1\}, \{Z, X_0\}, \delta, q_0, Z, r)$  and  $\delta$  is given by  $\delta(p, \epsilon, X_0) = \{(q, ZX_0)\}$ ,  $\delta(q, \epsilon, X_0) = \{(r, \epsilon)\}$ ,  $\delta(q, 1, Z) = \{(q, ZZ)\}$ ,  $\delta(q, 0, Z) = \{(q, \epsilon)\}$ . 4.5
- b) Find the Greibach normal form grammar equivalent to the following CFG: 4.5  
 $S \rightarrow AB$   
 $A \rightarrow BS \mid 1$   
 $B \rightarrow SA \mid 0$
- 14 a) Design a PDA to accept the language  $\{0^{2n}1^n \mid n \geq 1\}$ . 4.5
- b) Find a CFG without  $\epsilon$ -productions equivalent to the grammar defined by 4.5  
 $S \rightarrow ABaC, A \rightarrow BC, B \rightarrow b / \epsilon, C \rightarrow D / \epsilon, D \rightarrow d$

### PART E

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

- 15 a) State Pumping lemma for CFLs. Write the applications of pumping lemma for CFL s. 4
- b) Check whether  $L = \{a^i b^i c^i \mid i > 0\}$  belong to CFL or not. 6
- 16 a) Discuss about Multitape Turing Machines. Explain informally how they can 5

- simulate the moves of a Turing Machine
- 17 b) Write a note on Universal Turing machines. 5
- 17 a) How to identify deterministic Turing machine from nondeterministic TM 3
- 17 b) Write notes on the following: 7
- i) decidable and undecidable problems
- ii) Halting Problem of Turing machine.
- 18 a) Write the properties of recursive languages and recursively enumerable languages. 3
- 18 b) Write the Chomsky hierarchy of languages. Prepare a table indicating the automata and grammars for the languages in the Chomsky Hierarchy. 7
- 19 a) Define Turing machine [Write the tuple representation for TM]. 5
- 19 b) Design a Turing machine to identify the strings belong to the language  $L = \{0^n 1^n \mid n > 0\}$ . 5
- 20 Design the Turing machine to recognize the language:  $\{0^n 1^n 0^n \mid n \geq 1\}$ . 10
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